THE

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1912—1913.

WHEN these lines appear in print, the majority of our readers will be too busily engaged about their business to study a detailed review of the electrical doings of a past year. Everybody specialises nowadays, and therefore every reader knows what has been happening in his own particular line. Nevertheless, it is as well for us all to take a comprehensive view of the whole of the departments of the science and industry occasionally, and the passing of one year and the opening of another provide a fitting opportunity for brief general retrospection or review. To meet this need, and this alone, do we touch the subject here.

Notwithstanding the depressing influences of the recent Christmas weather, we approach the subject in a satisfied mood whether we look backward over the achievements in 1912 or venture forward into 1913. Our satisfaction is modified somewhat by the recollection that 1912, like the year that preceded it, was a period when the relations of employers and employed were seriously disturbed. The increasing cost of living coupled with the prevalence of excellent trade and the continuance in office of a Government credited with a willingness to grant legislation in a hurry at the bidding of organised labour, brought clamour from many sides for a larger share of the profits, and without here entering into the merits of such questions, we must remember them here as factors which during the year brought grave disquiet and handicap to those representing the control of Industry. Electrical engineering firms remember only too well how the strikes among the colliery workers, the transport workers, and the "not-in-the-Police-Court-sense" railway men, have harassed them in their productive and distributive operations, and all of us will profoundly hope that in view of the large concessions granted, or the lessons severely learned, industry will be allowed to settle down peacefully for awhile to handling a record volume of business. While it is right that the interests of the worker should be studied in our schemes of social legislation, nothing is so serious a disturbing factor in industrial affairs as sweeping legislative reforms passed without mature deliberation. If we appear to dwell too fully upon this point, it is because nobody can either faithfully record the past, or intelligently anticipate the future, without recognising how important an influence labour disaffection must ever have.

Passing now from larger matters and those which have a general bearing upon all sections of electrical and engineering activity, we may turn with the greatest possible satisfaction to the position of individual electrical departments. It does not matter which way we turn—with the solitary exception of the tramway field—there are evidences of a splendid improvement having taken place during the past year, and as we start out upon 1913, not only is there no falling-off in the rate of progress, but there is in prospect more business, in both the larger and smaller classes of manu-

factures, than ever before. One's thoughts naturally turn to the gratifying progress in electric heating and cooking, as the result of the cultivation of the domestic and trade consumer; to the large requirements of electrical supply authorities for new plant, and in some cases entire new stations; to the great headway that is being made in the wireless telegraph sphere; to the progress of railless electric traction and the petrol-electric 'bus; to the new telephone situation following the transfer, which is giving, and must continue to give, rise to very big requirements for apparatus and equipments both for new exchanges and for the users' premises (automatic working is the outstanding development of the year); to the extraordinary advance that was made in the electric power department, both independently of, and as a result of, the miners' strike, when hundreds of industrial works turned to public supplies of electricity for the first time; and finally, and quite as encouraging, if not more so than all the rest, the long-delayed movement in the railway electrification department which has come at last, as witness the great triple event of the closing months of 1912—the decisions to proceed with the equipment of 150 route miles of electric railway at Melbourne, of 79 track miles on the L. & N.W. Railway, and of 73 track miles on the L. & S.W. Railway. All of these will be worked on the direct-current system. The Central London tube extension to Liverpool Street was completed in 1912, and the East London is at last in the electrical contractors' hands, while the L.B. & S.C. Railway has brought the single-phase system into operation on some additional lines.

Now that we have got so far in the railway department, there is every reason to believe that even in this long prayed-for circle, widespread revival and conversion will speedily spread. Closer working arrangements have been entered into by many of the metropolitan tube, motor-'bus and tramway companies, which, it seems, must make for increased efficiency and convenience.

The triumphant progress of the steam turbine, which is now being built of no less than 30,000 KW. capacity, and the increasing use of the Diesel engine, which is being rapidly developed for ship propulsion, and will therefore soon be available in large sizes for central-station work, call for notice, and we should not omit mention of the start which has been made in the adoption of electric transmission on board ship.

Each of these items would make an excellent text for an article devoted solely to its own development and prospects, but we think the mere recital given above serves sufficiently to indicate broadly how general is the electrical advance that is now proceeding.

That the reorganisation of the Institution of Electrical Engineers, with the establishment of standing committees to deal with industry and research, will strengthen the position of the Institution and promote the best interests of all engaged in electrical work we all hope and believe, and we look forward confidently to a continuance of that prosperity with which the New Year has commenced.

THE AMERICAN UNDERWRITERS AND CANADIAN TRADE.

We publish elsewhere in this issue an exhaustive report to the Board of Trade, prepared by Mr. C. Hamilton Wickes, on the American Underwriters' Laboratories (Inc.), its constitution and the scope of its operations, and their effect upon the importation of British manufactures into the Dominion of Canada. As we have already indicated, this is one of the first pieces of work to result from Mr. Hamilton Wickes's appointment as H.M. Trade Commissioner in the Dominion, and we commend it, together with the conclusions and recommendations which it contains, to the serious study of all who are interested in the promotion and extension of British electrical trade across the Atlantic; more especially do we ask our manufacturers to weigh the whole matter as one concerning which it is their duty to have a conviction, and to express an opinion. Indeed, let all of us determine that, the matter having been carried thus far by one of His Majesty's representatives, whatever lies in human power to give the question a full hearing and a fair discussion shall be done; and if the definite proposal that is advanced commends itself as the best method of dealing with the situation that has arisen, let us all strive to ensure that something very tangible shall emerge.

Every student of the Canadian electrical trade position has something to say about the Underwriters' organisation and its adverse influence from the British electrical manufacturer's point of view; but perhaps, if we get to understand better, as this report may enable us to do, the reasons which gave birth to this undertaking, and the work that it has done in the way of fire prevention, and the absence of British electrotechnical co-operation and guidance in connection with its procedure, we may be able to clear away prejudices, the removal of which may prepare the way for the introduction of influences which will tell in favour of British manufacturers in the future.

At this juncture it is not our intention to pronounce any very definite view respecting the details of the new scheme, though we do not hesitate to say that in principle the proposal appears to contain very reasonable advice. The right thing for us to do at this moment is to invite opinions from those who are actively engaged in manufacturing and exporting. The Trade Commissioner has done his part, we have done ours in giving the matter such complete publicity, and it now remains for our firms—their principals, managers, and other experienced representatives—to express themselves and to get to work on this side considering the wisdom of the proposal, and devising means for carrying it into effect.

Briefly stated, what is recommended is that British electrical engineers should take a leaf out of the American book and equip their own laboratories in the United Kingdom, on the same lines as the American. The more the suggested British laboratory works in conjunction with the Chicago authority, obtaining the right to use its labels, the more likely is it that British manufacturers will gain the advantage not only in meeting the wants of Canada, but in even opening up to themselves the United States electrical market, for the use of the labels mentioned would carry equal commendation to all inspectors throughout North America. The necessity for co-operation must be emphasised. Independent British action in such a case would be fatal. It would seem that nothing short of a laboratory in England, which will be *practically an offshoot of the Underwriters' Laboratories (Inc.), of Chicago*, will meet the case. It must be run on similar lines, utilising the experience gained at Chicago, employing equally competent, but British, consulting and technical engineers. It is suggested that the article approved by label or tab should be accepted by both the British and the Chicago laboratories, the same careful system of experiments and tests being followed by the consideration of reports before they are issued, and

the adoption of the same, or a similar, system of labelling, tabs and inspection.

The foregoing is in barest outline the idea now advanced, but there are many reasons why the entire report should be read before anyone attempts to criticise it, for there are various details which, if ignored, would leave one with an incomplete idea of the position. One word more—let it be remembered that the Chicago organisation will welcome any such movement as is suggested in the hope of minimising fire risks, and is in no sense to be regarded as having hostile interests. British apparatus possessing outstanding fire preventive qualities will be welcomed on their merits if they bear the stamp or label of authority, and knowing the high quality of the material that our electrical manufacturers are in the habit of producing in the interests of public safety, we feel that it should stand a good chance of passing the test and report stages satisfactorily.

The Berlin Railway Conversion Scheme.

The Government scheme for the conversion to electric traction of the Berlin City, circle and suburban railways, has recently been engaging the attention of a Commission of the Prussian Diet. The project was brought forward in the last session of the Diet, but was postponed in consequence of the doubts expressed in various quarters, and also because proof was desired that the same results could not be attained by the use of more powerful steam locomotives and at a smaller expenditure than £6,300,000, the sum contemplated under the electrical scheme. In the meantime a fresh memorandum has been prepared and submitted for the consideration of the Commission. It appears that the steam interests have presented a scheme for a six-axle tender locomotive weighing about 100 tons, and working with superheated steam. The document states that a comparison of this type with the proposed electrical system shows that the former cannot compete with the latter either from a working or an economical point of view. If guarantees could be obtained for the certain carrying-out of the services it would only be possible to operate 32 steam trains per hour in either direction on the City railway, with a seating capacity for 19,500 passengers, whereas electrical working will permit of 40 trains per hour with accommodation for 24,400 persons. The introduction of heavier locomotives would involve an outlay of £4,450,000, as compared with £6,300,000 in the case of electricity, but the annual expenses, including interest and depreciation on the new capital, would be £295,000 less in the case of electrical working. The deficiency on operating the railways in 1910 was £18,000 and it was £23,000 in 1911, whilst in 1916 the deficit, without providing for depreciation and interest on capital, would amount to £117,000 with electricity, and as much as £498,000 with steam locomotion. It is therefore considered that the latter can no longer be taken into consideration. An increase in the passenger fares is foreshadowed on the ground that at least the deficiency in working must be avoided and 4 per cent. interest obtained on the new capital expenditure. A further point of interest relates to the supply of power for the operation of the railways. As will be remembered, a private group of manufacturers have offered to furnish the necessary energy for a period of 30 years by the erection of central stations, at least one of which would utilise lignite as fuel. The offer ranges from 3·3 pfennigs to 3·8 pfennigs (·387d. to ·446d.) per KW.-hour delivered on the railway side of the station, and according to the quantity required.

It appears that the State railway authorities have the option of purchasing the whole of the generating plant and transmission lines during the term of the agreement, on certain conditions which have been formulated. This is a new proposal, the object of which is presumably to disarm the opposition which has been aroused by the possibility of the creation of a monopoly in the supply to the railways. No obligations have, however, been assumed by the State railway authorities in the matter, and it is, therefore, possible to enter into negotiations with other undertakings for the supply of energy, as occasion may arise. The proceedings before the Commission of the Prussian Diet elicited the statement that trials have already been made of new types of steam locomotives, but that electrical working is more economical, and that the possibility exists of an extension of the latter method on other railways, apart from those in Berlin.

Train Lighting and Burning.

In our issue of September 27th we drew attention once more to the dangers of lighting railway trains with gas, referring particularly to the accident at Ditton Junction, whereby 15 persons lost their lives, and several were burnt. We had no hesitation, in view of the evidence then available, in ascribing the burning of the wrecked coaches to the use of gas, and the report of Lieut.-Col. Sir H. A. Yorke to the Board of Trade, of which we give extracts on another page, fully confirms our conclusion. The Inspector recalls that Major Pringle, reporting on the Hawes Junction accident in 1911, expressed the view that electric lighting should be adopted in place of gas, and he supports this recommendation, stating that "so far as safety is concerned, there can hardly exist in anyone's mind a doubt that electricity is the better." He thinks that the railway companies would be wise to recognise this fact, and to adopt electricity on all their main-line trains before they are compelled to do so by the pressure of public opinion.

We gather from the report that, after the previous accident, the Board of Trade made representations to the railway companies to the same effect, and we welcome this praiseworthy action. Our contemporary, the *Gas World*, objects that the Board of Trade, in doing so, has gone ahead of public opinion, but surely this is a matter for congratulation rather than reproach—it is a pity the phenomenon is so rare! Our contemporary makes a mysterious reference to "the more than doubtful record of the proposed substitute, electricity," which, we must confess, has left us dumbfounded.

We challenge the *Gas World* to cite a single instance, in any part of the world, where the electric lighting equipment of a railway train has even been *accused* of causing a fire after a collision. It should know better than to remark that "the contemplation of an express train rushing through the night for two hours without a stop with a short-circuit at work is not consoling." If fire were to break out—from any cause—on a train in motion, common sense would stop the train and let the passengers get out. But who ever heard of a short-circuit on a train enduring for even two minutes?

Major Pringle's report referred to the Hawes Junction disaster as the first occasion on which it could be "proved beyond question" that the fire was caused by burning gas; but on previous occasions Board of Trade inspectors had pointed out the dangers of gas, and we have before us a list of no fewer than 13 instances since the year 1887 in which railway accidents abroad were followed by fires ascribed to the presence of gas. We are glad to know that the number of British coaches lighted with electricity is increasing yearly, but may not the process of reform be hastened by the teachings of foreign experience, as well as by our insular holocausts?

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INCREASING STEAM PLANT EFFICIENCIES.

BY EDWARD INGHAM, A.M.I.M.E.

CONSIDERING the high working efficiencies of the boilers, and the low steam consumptions of the engines and turbines at electric lighting and power stations which are obtained at the present time, it would appear that the scope for further improvement is somewhat limited. With regard to the engines and turbines, this is, perhaps, to a large extent the case; but as regards the boilers, there are various ways in which it seems possible to increase the present efficiencies, and in this article it is proposed to point out how such improvements may be effected.

The proper combustion of the fuel is, of course, a point of the first importance ; but so much has been written bearing on this question, that little need be said about it here. There can be no question that excessive losses may, and do, occur as a result of imperfect combustion, the admission of excessive quantities of air to the furnaces, &c. Indeed, in a great many instances the working efficiency might easily be improved by 5 or even 10 per cent. by properly regulating the air supply. As illustrating what can be done in certain cases by careful attention to the boiler plant, it might be mentioned that at the Loughborough Electricity Works the generating costs per unit were reduced by no less than 44 per cent. merely by using a more suitable class of fuel, reducing air leakage and generally obtaining more perfect combustion of the fuel.

Where many boilers are concerned, as is the case at all large central stations, it is certainly advisable to install a CO_2 recorder in the boiler room, as such an instrument provides the fireman with a means of ascertaining whether or not he is getting the best results, and he can then regulate the air supply, &c., accordingly. After all, the fireman is a most important factor in the attainment of high boiler efficiencies, particularly where hand-firing is practised, and for this reason it will, generally speaking, pay to adopt a bonus system for the fireman, as a pecuniary incentive will certainly go a long way towards reducing the coal bill. The large influence the fireman has on the working results is well illustrated by tests which have been carried out from time to time. In one instance four good stokers were made to fire a large Lancashire boiler, one after the other, the conditions being maintained as far as possible the same, and it was found that there was a difference in economy of as much as 23 per cent. between the best and the worst fireman. In another test, carried out by Messrs. Davy Bros., of Sheffield, five men were made to fire the same boiler, and whereas the best man evaporated 9 lb. of water per lb. of coal, the worst only succeeded in evaporating 7·4 lb., representing a difference of 22 per cent.

Considerable savings may often be made by carrying out calorific tests of the various fuels available, combined with practical trials extended over a few days' supply to the station. This enables the engineer to choose the fuel which costs least per unit, and by so doing the annual coal bill may often be reduced very considerably. Coals having high calorific values, and free from dirt, are not always the cheapest to use.

Mechanical stoking, whilst it may not show much advantage over hand stoking in the case of a small station, will certainly do so where large stations are concerned, as by its adoption the firing is more even and regular, and the combustion, therefore, more efficient, whilst the losses arising from the admission of large quantities of cold excess air through the fire-doors and through holes in the bed of fuel are avoided.

The cost of labour is also greatly reduced, especially when the machine stokers are used in conjunction with coal elevating and conveying plant.

Good draught is another important factor, as without such, perfect combustion is impossible. Mechanical draught, either forced or induced, possesses a great advantage over natural draught, inasmuch as it enables the fires to be worked thicker, which tends towards economy, whilst the air required for combustion is brought into more intimate contact with the fuel, and more coal per sq. ft. of fire-grate can be burned than would otherwise be possible.

At electric generating stations in particular, mechanical draught is of great advantage, because at such places the load frequently changes quickly and to a large extent, owing to fogs, dark clouds, &c. With mechanical draught the intensity of the draught can be regulated according to requirements.

One way in which it seems possible to increase steam boiler efficiencies is by heating the air required for the combustion of the fuel before admitting it to the furnaces, the heat in the products of combustion being utilised for this purpose. It has indeed been found possible to effect an economy of 15 per cent. in this way by suitably arranging the boiler house and flues, and there is, no doubt, considerable scope for improvement in this direction.

It has been frequently suggested that the furnace of a steam boiler should be separated from the boiler itself, and the fuel burned in a producer. There is every reason to believe that the adoption of this suggestion would result in much higher efficiencies. A producer is certainly better adapted for the proper combustion of coal than a fire-grate, as it would permit of better regulation of the gas and air supply with less draught, whilst losses from radiation could be much reduced. In a paper read before the International Association for the Prevention of Smoke, some years ago, by Prof. C. H. Benjamin, it was pointed out that "when we compare the comparatively sluggish and badly-regulated coal fire of the power plant with the perfect combustion and intense heat of the open-hearth steel furnace, we are justified in predicting an improvement in the former."

It was further stated that "when the coal fire is removed from its inconvenient and uneconomical position under the boiler, and the combustion is perfected in a brick-lined reverberatory furnace operated under forced blast with air heated by regenerators, the heat efficiency and the evaporative capacity of steam boilers will be enormously increased. The secret of good combustion in boiler work, as in metallurgy, is complete combustion of the coal in a separate receptacle and the maintaining of the gases at a very high temperature before coming in contact with any cooling surface whatsoever."

The fundamental reason why gas and air can be burned more economically than coal and air is that both the former are gases. Air cannot be intimately co-mingled with solid pieces of coal, but air and gas can be brought into intimate contact with one another in the correct proportions at the proper time and place for the chemical combinations known as "combustion" to take place. This means that there is little or no useless residual "free" air to be wastefully heated up. By gasifying the coal in a separate brick furnace close to the boiler, and then burning it with all the sensible heat of its production by the introduction of heated air in such a way as to thoroughly intermingle the two, an enormous gain is obtained. The combinations of combustion can also be completed prior to the gases coming into contact with the water-cooled boiler plates, which is another reason why great gain results. Further, the whole of the boiler flue surfaces are usefully employed in absorbing heat instead of acting more as cooling surfaces as in the ordinary ashpit.

An external furnace has recently been designed on these lines by Mr. E. C. Mills, of Manchester, and in tests made on a Cornish boiler, with and without this furnace, by Mr. J. B. C. Kershaw, F.I.C., of Liverpool, the following results were obtained :—

	Ordinary furnace.	*Mill's furnace.*
Lb. of water evaporated per lb. of coal from and at 212°F.	6·99	11·2
CO_2 in flue gases	7·32	14·6
Thermal efficiency...	51·85 %	77·1
Temperature of chimney gases	518° F.	372° F

It should be mentioned that no economiser was used in connection with the boiler tested, the efficiency of which with the ordinary furnace is low. The increase in efficiency which resulted from the adoption of the external furnace is, however, very considerable, even when the great scope for improvement in this particular case is taken into account. The writer understands that further tests on larger and more efficient boilers are about to be made with the object of further proving the merits of the external furnace, and in a subsequent article he hopes to give the results of these tests, together with a description and an illustration of the furnace.

Some reference should be made to the adoption of liquid fuel for steam generation purposes. With such fuel it is much easier to regulate the quantity of air required for combustion, and losses due to the admission of much excess air may be thus reduced to a minimum. It is stated that 10 or 15 per cent. increase in efficiency is possible by the employment of liquid fuel instead of coal, but it is doubtful if such is the case. The writer holds the opinion that, as far as economy is concerned, liquid fuel, owing to its high cost, is not likely to take the place of coal, but it may certainly be used to great advantage in certain cases. Thus, at an electric generating station, where sudden demands for steam may be made at any moment, it will be obvious that, if the fires could be made to respond quickly to any such demand, great benefit would result. This, of course, is not possible with solid fuel, but by means of suitable burners oil fuel could be blown on to the fires, and the necessary sudden accession of the fires thus obtained just when desired.

The heat generated in the boiler furnaces has to pass through the plates before it can be usefully employed for evaporating the water into steam. It is obvious that the transmission of heat from the hot furnace gases to the water in the boiler should be as free from resistance as possible, and hence it is absolutely necessary that the plates should be kept clean both on the water side and the fire side. It is quite impossible to obtain high efficiencies if the plates be allowed to get coated over with scale on the water side and soot and dirt on the fire side. According to Mr. Stromeyer, of the Manchester Steam Users' Association, a layer of average scale $\frac{1}{10}$th in. thick offers as much resistance to the passage of heat as a plate of steel 10 in. thick, whilst grease is ten times worse than scale. Hence the importance of keeping the plates clean. The figures quoted by different writers to show the losses due to scale should be taken with the proverbial "grain of salt," because so much depends upon the nature of the scale. Excessive thicknesses of some forms of scale have less effect in impeding heat transmission than thin layers of other scales.

Recent experiments and researches have shown that even with thoroughly clean plates, steam boiler efficiencies are not nearly so high as they might be. This is apparently due to the fact that under working conditions a stationary non-conducting film of gas clings to the fire side of the plates, whilst a similar film of water attaches itself to the water side of the plates. These films seriously impede the free transmission of heat from the hot gases to the water and so materially reduce the efficiency of working. It has been demonstrated repeatedly that if the hot gases and the water be moved rapidly over the plates, the rate of heat transmission is enormously increased, this being in all probability due to the fact that by so doing the non-conducting films referred to are removed from the plates.

The question of moving the hot gases and the water over the plates at high speeds is therefore one to which designers of steam boilers might in the future give serious consideration, as there is no doubt a large field open for improvement in this direction.

In his book on the "Steam Engine and other Heat Engines," Prof. Perry states that "Whether a tube be made of copper or iron or brass is of no consequence, except as to convenience and oxidation by the flame. The real resistance to the passage of heat is not due to the bad conductivity of the metal; it is due to the fact that the particles of hot gases will not come up fast enough to the surface to get cooled, and the particles of water will not come up fast enough on the other side to get heated."

Again: "We want the surfaces of the metal wall to be scrubbed, the one with hot gases and the other with circulating water, and the student who pays most attention to simple experiments on convection is most likely to invent the best boiler. Probably the best boiler will be one in which a flame or hot gas tube surrounds or is surrounded by a water tube, the gas and water flowing fast in opposite directions."

Efficient circulation and agitation of the water in steam boilers are very important factors in the attainment of high efficiencies. The rate at which heat is transmitted from the hot furnace gases to the water in a boiler depends upon the rate at which the water can carry the heat away from the heating surface, and hence the more efficient the circulation, the more efficient will be the heat transmission. In ordinary boilers, such as the vertical and the Lancashire, the circulation is defective, whereas in a well-designed water-tube boiler it is systematic and thorough. Experience appears to show that water-tube boilers are slightly more efficient than Lancashire boilers, this being due, no doubt, very largely to the better circulation which obtains in the former. When it is remembered that a Lancashire boiler, notwithstanding its defective circulation, will give an efficiency of nearly 80 per cent., it will be obvious that this type of boiler might be made extremely efficient if some method of improving the circulation could be satisfactorily applied. Special circulating devices have been patented, suitable for such boilers, by means of which, it is claimed, the working efficiencies may be increased by from 5 to 10 per cent.

Agitation of the water in boilers, as might be expected from what has been said with regard to circulation, is another way in which greater efficiency could be obtained. Thus, it is a well-known fact that water placed in a pan over a jet can be made to boil much more quickly by constantly stirring the water than when the water is allowed to remain still. A locomotive boiler, when used on the railroad, will evaporate a far greater quantity of water in a given time than it will when used as a stationary boiler, this being, no doubt, due to the shaking and agitation the water receives during transit. If it were possible to rock our boilers mechanically, we might reasonably expect to obtain better results.

The setting of steam boilers is not always carried out to the best advantage, in consequence of which much avoidable loss often occurs. Those parts of the setting which rest in contact with the boiler plates should be reduced in width to the absolute minimum, so that as little heating surface as possible will be covered up. The best setting is that in which all the parts in contact with the plates are made of a rounded form, as in the "Poulton" system. With such a form, practically no useful heating surface is lost. In a Lancashire boiler, with the ordinary form of setting, as much as 80 sq. ft. of heating surface is lost in some instances. It may be mentioned that there is no necessity to make the seatings 3 or 4 in. in width, as is usually done. A width of $1\frac{1}{2}$ in. is quite sufficient to support the heaviest Lancashire boiler when full of water.

In building the side walls of the setting it is always advisable to provide an air cavity in the walls, with the object of preventing loss of heat by radiation through the setting. Air is a very good insulator, and the provision of a stagnant air cavity round the setting effectually prevents loss. The makers of the "Poulton" setting, in addition to building a cavity in the side walls, also provide one underneath the boiler, the importance of doing so being well illustrated by the following example:—"At a large electric light and power station where a range of 10 boilers is installed, it was found that the temperature of the clay underneath the concrete foundations, 10 ft. below the bottom of the boilers, was as high as 280° F. These particular boilers were worked night and day by means of forced draught. A huge mass of material was thus maintained at this high temperature day and night, by a direct waste of useful heat"—which, of course, was constantly flowing into the subsoil and being dispersed.

A certain amount of loss by radiation is unavoidable, but by providing air cavities in the way pointed out, covering the boilers and steam pipes with good non-conducting composition, &c., the losses may be reduced to very small dimensions. As a further preventive against radiation, the brick walls may be carried up to the top of the boilers and then roofed over so as to form a hot-air chamber, in addition to the non-conducting covering.

Much loss frequently occurs through allowing the non-conducting covering to become defective. Many types of covering are perishable, and it is therefore advisable to examine the material periodically to see that it is in good condition.

Generally speaking, the quantity of heat lost by radiation from a hot boiler averages about 10 per cent. of the total heat of combustion. This figure might easily, in a great many instances, be reduced to 7 or 5 per cent., so it is obvious that this question of radiation is one of considerable importance.

It is not generally realised to what extent loss may occur through constant fluctuations of the water level in steam

boilers. By maintaining a constant water level and feeding regularly, a more uniform steam pressure, drier steam, and an improved circulation may be obtained, all of which tend to effect economy in working. Hence, great care should be exercised on the part of those in charge of steam plant to prevent fluctuations of water level and to feed regularly.

This is not a difficult matter when the load is a steady one, as at a cotton mill, but at power stations such conditions do not prevail, and hence the adoption of an efficient automatic feed-water regulator will prove to be of great advantage at these places. From comparative tests which have been made on boilers with and without automatic feed regulators, it appears that an economy of 5 to 10 per cent. may be effected by means of the regulators, the best results being obtained where the load fluctuates a good deal.

In conclusion, some reference should, of course, be made to the importance of utilising some of the waste heat from steam boilers. A large proportion of the heat generated by the combustion of the fuel in the furnace is not used in evaporating water into steam in the boiler, and passes away towards the chimney stack, and it is, therefore, necessary to employ suitable means of utilising some of this heat. Fuel economisers, superheaters, &c., are employed for this purpose, and by their adoption the fuel consumption may be reduced by anything up to 15 per cent., depending on conditions. These accessories are so well known and familiar to station engineers that little need be said about them, except that the remarks already made regarding clean plates, both on the water side and the fire side, high rates of flow of gases and water, &c., apply equally to economisers as they do to steam boilers.

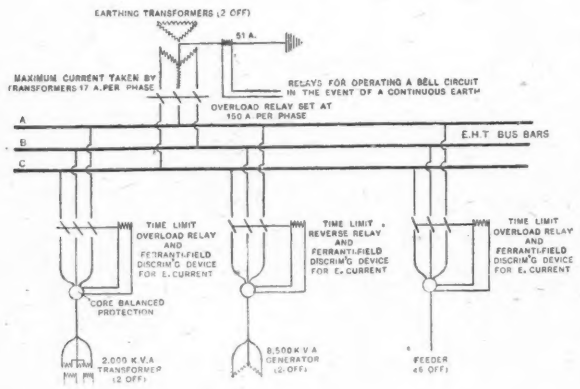
CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Earthing the Neutral.

Mr. Peck's paper upon "Earthed and Unearthed Neutrals on Alternating-Current Systems" has raised an interesting discussion. The majority of the speakers agreed upon the question of earthing, but none of them appear to give reasons why the current should be limited or unlimited. The question of earthing had to be settled here some 18 months ago owing to the adoption of a three-phase supply, and I think the following information will be interesting to your readers.

The two and three-phase systems are interconnected by


EARTHING TRANSFORMERS (2 OFF)
51 A.
MAXIMUM CURRENT TAKEN BY TRANSFORMERS 17 A. PER PHASE
RELAYS FOR OPERATING A BELL CIRCUIT IN THE EVENT OF A CONTINUOUS EARTH
OVERLOAD RELAY SET AT 150 A PER PHASE
A
B
C
E.H.T. BUS BARS
TIME LIMIT OVERLOAD RELAY AND FERRANTI-FIELD DISCRIM'G DEVICE FOR E. CURRENT
TIME LIMIT REVERSE RELAY AND FERRANTI-FIELD DISCRIM'G DEVICE FOR E. CURRENT
TIME LIMIT OVERLOAD RELAY AND FERRANTI-FIELD DISCRIM'G DEVICE FOR E. CURRENT
CORE BALANCED PROTECTION
2,000 K.V.A. TRANSFORMER (2 OFF)
8,500 K.V.A. GENERATOR (2 OFF)
FEEDER (6 OFF)

Scott-connected transformers, and the first point I had to decide was to provide an earth when the transformers were supplying three-phase current. The capacity of the transformers is 1,000 K.V.A. each, and at light loads they supply three-phase current to several feeders.

It was undesirable to earth the three-phase system through the neutral connections of the transformers, the chief reason being that should an earth develop on any of the feeders, the overload relays on the transformers would operate and thus cut off all the supply, including the earth connections, without indicating the faulty feeder. Up to the present, earthing through a resistance on A.C. systems only follows a similar arrangement with a D.C. three-wire system at 500 volts.

The use of limiting devices now generally employed on E.H.T. three-phase systems causes an abnormal rise in pressure in the neighbourhood of the fault. On the other hand, to allow 500 amperes to stray between the fault and the neutral point of the system is not beneficial either to gas, water and telephone companies' property, or to the distribution system. It was, therefore, necessary to adopt some other method of overcoming these difficulties.

I give below the advantages of the arrangement that has been in use in Sheffield during the past 18 months. The diagram of connections is shown herewith, which, I think, is self-explanatory :—

1. The personal element of switching a working generator or transformer to earth is obviated.
2. No expensive automatic selecting device is required.
3. The earth current is limited to 51 amperes, which is sufficient to trip the Ferranti-Field discriminating device.
4. The earthing device was built by the British Electric Transformer Co., and is in the form of a transformer arranged with primary star-connected and secondary delta-connected. Having the secondary delta-connected ensures that the neutral point on the primary is always at earth potential, as proved by experiment.
5. The earthing transformers are arranged to operate the trip coils of the respective switches in parallel with the overload and reverse relays.
6. The units per hour taken by the earthing transformer are 1,250 watts. The capital cost was approximately £150.

S. E. Fedden, *Manager.*

Electric Supply Department, Sheffield,
December 21st, 1912.

[This arrangement was referred to in our article on the Sheffield undertaking, on September 6th last.—EDS. E.R.]

Electric Cranes.

I was rather interested in an article appearing in a recent issue dealing with electric cranes, and would be glad if the author would further enlighten me on this important subject. The controlling gear of the D.C. crane consists of a double-pole distribution board, controllers that can be wired for either single or double pole, and eight trolley wires between the girders.

Why is the crane wired single pole ?

I understand that the overwinding arrangement is a knife switch erected on the crab, and at the proper time this switch opens and breaks the main circuit.

If I am correct in this assumption, I should hardly call it modern practice ; most cranes have a circuit-breaker connected in the hoisting-motor circuit, and, erected in the control cabin ; this is held in position by means of a coil which, when short-circuited, trips and opens the breaker. A small switch, which takes the form of a push-button, is erected on the crab, and employed to do this.

This means more trolley wires, I know, but I think it is worth the extra expense as opening the main circuit on the crab has some objectionable features.

Regarding the crane wired for alternating current, I should obviate the use of a common main by putting up another trolley wire.

The practice of having a main common to two or more motors is one not to be commended, because faults may arise in the wiring which would greatly increase the danger of the hoisting motor brake operating when cross travelling or long travelling.

My remarks regarding the hoisting limit switch on the D.C. crane hold good for the A.C. one, and finally, I think there are more efficient controllers on the market for controlling three-phase asynchronous motors than those shown in the diagram ; in any case the wiring at the controllers is obviously wrong, because we have a short circuit between two phases of the supply on all controllers.

J. L.

Glasgow, *December 26th*, 1912.

The Case of the Sub-Man.

I and other members of the E.T.U. have been interested readers of the correspondence which has appeared in the columns of the REVIEW during the past weeks, from sub-station and shiftmen, about their woe-begone condition.

The whole correspondence bristles with contradictions; they first of all assume that they occupy a unique position, being a sort of aristocracy of the electrical industry, upon whom shines the reflected glory of the chief engineers (I see the Burgh of Paisley requires the services of one of these embryo Faradays at £1 5s. per week), and in the next sentence they say that milkmen, yardmen and others can, and do, accomplish their work.

They are all agreed that Trade Union principles are not applicable to their grade, and the unanimity with which they refrain from telling us why is certainly convincing.

The objective apparently is, *vide* "Motor-Generator," to form an association, to be called "The Electrical Shift Engineers' Association," the object being the furthering of the living wage cause (rate not stated), and to be recognised as a body of men of education and training; the association not to be run on Trade Union principles. The I.E.E. is to be approached for "recognition," and the trick is done. "O the brave music of a distant drum."

The more one reads this correspondence, the more apparent does it become that, however well-intentioned the writers may be, they lack a true appreciation of the factors which govern the wages and working conditions of any industry, and the sooner they get rid of the shibboleth "profession," and the snobbishness attaching thereto, the better it will be for themselves.

The "chief" is merely a deputy for the employer, and, from the nature of his position, has to show a return on the undertaking, and the price of labour, especially unorganised, is more easily squeezed than the price of Osram lamps.

If "Motor-Generator" and his colleagues are really serious in their contention that "to strike one blow for this great cause" is to form an "Association" to obtain "recognition" from the I.E.E., they had first better visit a local menagerie, obtain access to the lion's den just before feeding time, say a few prayers, and await the result.

The interests of the station attendant and the wireman are identical; both sections are necessary for the efficient working of the industry, they are interdependent, their economic circumstances are due to the same primary causes, and a multiplicity of organisations will not find the solution. The Electrical Trades Union is an accomplished fact, has a considerable body of central station men in its ranks, has improved conditions for large numbers of electrical workers in the various grades, and will welcome recruits on the principle of "each for all and all for each."

J. Potter,
District Secretary, Electrical Trades Union.

London, N.W., *December 28th*, 1912.

High-Tension D.C. in Mines.

I am much interested in Mr. Sydney Walker's article entitled "A Plea for the use of High-Tension Constant Continuous Currents in Mines." Under the heading "Questions of Economy," he states that with a three-phase system at a working pressure of 3,000 volts in a mine having five miles of cable the combined losses are in the neighbourhood of 500,000 Board of Trade units per annum. I have no doubt Mr. Walker has gone very carefully into these figures, and do not in any way wish to criticise them, although they appear somewhat high. What I should like to know is—

1. What percentage loss this is of the total Board of Trade units consumed?

2. What Mr. Walker estimates the loss would be in a high-tension continuous-current system having a proportionate length of cables with, as I understand from his article, full-load current circulating throughout the whole system continuously?

Unless some such information is to hand, it is difficult to form any idea of the merits of the two systems from an economic point of view.

Civil Engineer.

The title of Mr. S. F. Walker's article in your issue dated December 27th, 1912, as above, disarms any criticism on the point that he writes as an advocate and not as an impartial judge. Nevertheless, as an engineer who has devoted some few years to electrical work in mines, the writer would like to put forward a few points which appear to discount somewhat the advantages claimed on behalf of the above system, taking these *seriatim*:—

Two Cables versus Three.—Since three-core cables must (and should) always be used underground on the three-phase system, the great advantages of and greater simplicity in making connection to the concentric cables advocated for the H.T. C.C.C. system are not very apparent. In neither case must any attempt ever be made to joint the cables when alive. The majority of jointers prefer jointing three-core cables, and these have the additional advantage that the cores need not be cut in order to take off a branch circuit.

Pressure Variation between the two cores at Different Points.—The writer grants that should this difference of pressure in any particular district (say, at the coal face) be so small that a shock would be harmless, some advantage might be claimed, but this hardly appears probable, as any difference of pressure above, say, 100 volts, should be regarded as dangerous from a "shock" point of view. The spark danger would exist at any pressure. A distinct disadvantage would appear to be, that although the cable on the C.C.C. system would normally carry the constant current at a certain difference of pressure between the cores, it would be neither advisable nor practical to grade the various cables to withstand this pressure only, as the pressure might vary to such a large extent when alterations or additions to the motors were made. In fact, it seems to the writer that the whole of the cables should be built to withstand the maximum pressure likely to be generated, otherwise continual change of cables would be necessary, and great liability to serious accidents incurred through the breakdown of cables under higher voltages than they were built for. A similar problem will have to be faced if the total load at any time exceeded that contemplated when laying down the plant. This compares disadvantageously with the three-phase system, where the sectional area of the cables can be increased by simply putting others in parallel at any part of the system required.

Liability to "Short."—Surely, Mr. Walker is not serious in his statement that, because there are three cores as against two, liability to "short" is increased sixfold?

Cables made by any of the leading firms in this country are not likely to "short" (barring misuse) unless mechanically damaged, say, by a fall of roof, in which case there is little, if any, advantage in a two-core over a three-core cable.

Again, if a "short" occur in a C.C.C. system all apparatus beyond the "short" is put out of action, as Mr. Walker states; but, on the other hand, a similar occurrence on a three-phase system will *not* necessarily put the whole service out of gear, as Mr. Walker suggests. Part of the system only will be cut off in this case also, owing to the operation of a trip coil or fuse controlling the section containing the fault. Yet again, in the C.C.C. system, surely local heating can take place at a "short," since this will carry the whole current? The contact is not likely to be so good that heating *never* takes place.

Armouring.—The difficulty of repairing armouring is not so great as Mr. Walker imagines. The best way (apart from putting in a new length of cable) is undoubtedly to use a joint box. It must be remembered that on a large system there will be a number of these boxes, say, 100 yd. apart with a very heavy cable, and 400 or 500 yd. apart with a light one. One extra joint box where the cable has been damaged, is not a very serious matter. It may be of interest to state here that joint boxes which *efficiently* bond the armouring can be obtained from cable firms who have made a special study of mining work. Serious damage to the armouring is not a frequent occurrence where the cables have been installed in the right way, and are properly looked after.

Danger from Shock.—Cases of shock, similar to those mentioned by Mr. Walker, are not inherent in, or peculiar to, the three-phase or any other system, but are usually caused by the lack of knowledge or carelessness on the part of those who are responsible for the installation or the working of the system. The writer cordially endorses the opinion that

a great deal of the trouble in the past has been due to the fact that many of the designers of electrical appliances for use in mines had very little practical knowledge of mining conditions. This, however, was to some extent the fault of the mining people themselves, sufficient discrimination not always having been employed by them in placing their contracts, the question of first cost frequently determining their choice.

Economy.—It is rather disappointing to find under this heading that no attempt has been made to compare the two systems. The author does not say how he arrives at the high figure given for hysteresis and magnetising losses.

As against this, too, must be taken into consideration the fact that the C^2R losses in the C.C.C. system will be proportionately greater when only a few motors are in use, more particularly when they happen to be at the far end of the line.

Again, while on the subject of economy, the first cost of the cables in the C.C.C. system would appear to be rather high, since their sectional area must be the same throughout, and, in the writer's opinion, to grade the dielectric strength would be likely to lead to trouble in the future when alterations or additions were made.

Other disadvantages suggest themselves, but for the present purpose space and time have limits.

As the subject of electrical work in mines must be of great interest to a large number of your readers, further articles on the subject would probably be welcomed.

L. C. Trevor-Roper.

Sheffield, *December 30th*, 1912.

Having had some experience of mining electrical appliances, I read with some interest the contribution by Mr. Walker in your current issue which naturally attracted my attention, especially as some of the statements appear so wide of what my experience points to, that I think, for the sake of the many more or less connected with mining work who read your paper, they should not be allowed to go unchallenged.

This is my excuse for writing on the subject, and airing some views which are my own, and which I shall think correct till some one proves them otherwise.

On one matter I agree with Mr. Walker, viz., the unreliability of armoured cables carrying several conductors of greatly varying potential and phase.

A remedy, however, for this, suggested long ago, which would, I believe, have been tried but for the bugbear of a little experimental initial cost, is as follows :—

Adopting an alternating system, either single-phase or polyphase, with transformers, run separate well-insulated and braided conductors in iron tubing—not of just the ordinary house-wiring strength, but more resembling the pipes used for carrying steam or compressed air, but, of course, smaller, so as to give equal, or even greater, tensile strength, with, of course, only a fraction of the cost of the steam or air pipes. The joints to be safe ones, both electrically and mechanically, by using either faced flanges, screwed couplings, or some other reliable arrangement. Junction-boxes and transformer-boxes of equally strong mechanical construction to be similarly joined to the tubes, and the whole casing to be well "earthed" on the surface, and at as many places on the way in the mine as reliable "earth" can be found.

The two advantages claimed for this arrangement are :—(1) Being entirely enclosed, high-tension currents (up to 5,000 volts or more) could safely be employed ; (2) the cables being separate, could easily be tested for "earthing" or breakage from the surface, and the fault easily rectified. The cables from the transformers to motors, if only carrying current at 100 volts or thereabout, could be given the flexibility required for coal cutters, &c., without danger or much risk of the insulation giving way.

This system, too, would get over most of the variable potential difficulties to which Mr. Walker refers.

With direct current (or continuous, whichever term you prefer ; I prefer the former, being shorter, and generally understood to mean the same) we have not yet any system or practical means of reducing to low pressure that can be enclosed efficiently without the difficulties inherent to running machinery enclosed, or at the same very small loss as obtains in a transformer. On this point, iron losses in transformers of reasonable size and decent construction rarely exceed 2 per cent. of the energy transmitted, and an instance came before me where one of 500 watts capacity, 200 to 50 volts, 50 cycles, tested by a Leeds Corporation inspector, showed only 2 watts iron loss.

Then, coming to the working of a direct-current motor with a by-pass, which is used to cut it out by short-circuiting, if not working, this must be either automatic or under hand control—I presume the latter ; this requires, it seems to me, very reliable and conscientious use for one machine not to interfere with others on the same mains, and the beautiful conception of the voltage and consequent shock risk lowering as one gets further in the mine, can only hold good whilst all is in apple-pie order. Past experience does not warrant the assumption, however, that series apparatus can be relied on to keep in good order.

On the other, both transformers and alternating motors are amongst the electrical items of which the maintenance is easiest and least expensive, and seem to give the lasting solution which will, I believe, when those who have the choice of the electrical plant are sufficiently educated, be more and more used.

Apologising for the length of this, which, however, but briefly explains what could be further demonstrated—

A. W. Bennett.

Leeds, *December 30th*, 1912.

NOTES FROM INDIA.

[FROM OUR SPECIAL CORRESPONDENT.]

Calcutta.—An effort is being made to bring together the members of the I.E.E. ; invitations have been sent out to the various members, associate members, &c., to foregather at Peliti's restaurant at dinner with a view to having a preliminary talk as to the best way to arrange for frequent meetings and discussion. This is a step in the right direction, because, even though members of the Institution may be rivals in business, there is no reason why they should not meet outside business hours, on neutral ground, and have friendly discussions on technical points of interest to all. The last meeting of Calcutta members was held in 1903, with the late Father Lafont, C.I.E., in the chair, when an interesting paper on "Electrical Instruments for India" was read by Prof. Bruhl, of Sibpur Engineering College.

Lahore Electric Supply Co.—The official opening of the new electrical power house of this company took place recently, and there is every prospect of a good load coming on soon. Mr. Jensen, the chief engineer, is responsible for the design and working of the installation, and in him the directors have been fortunate in finding a capable and enterprising young engineer who will leave nothing undone to ensure the success of the undertaking.

Simla.—While the Imperial Government is down in Delhi for the cold-weather months until March, 1913, a good deal of installation work is certain to be carried out in Government buildings and private bungalows in Simla. Even at present a couple of local small wiring contractors are reaping a good harvest before the bigger firms of Calcutta and Bombay send representatives up there. The municipality have prepared very rigid rules for wiring work, and are open to register the name of any reputable firm who bind themselves to adhere to these rules when carrying out work. This is a wise precaution, as many of the Simla buildings are wooden ones, where a fire caused by an arc or a short would lead to disaster.

Rampur.—Messrs. Siemens Bros. have been successful in obtaining the contract for the city lighting ; the machinery will consist of Ruston crude-oil engines and Siemens dynamos, with accumulators. About 14 miles of streets are to be electrically lighted.

PROCEEDINGS OF INSTITUTIONS.

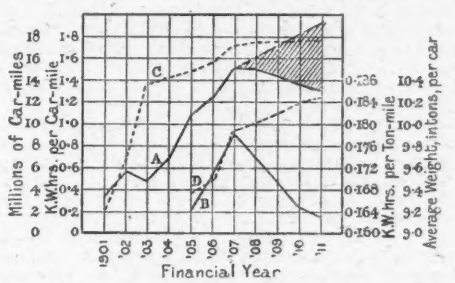
Tramway Feeding Networks.

By J. G. CUNLIFFE, M.Sc.Tech., and R. G. CUNLIFFE, M.Sc.Tech.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Manchester, December 3rd*, 1912.)

THE object of the paper is to present a suggestive treatment of the modifications which, as a result of continued development, are rapidly becoming necessary in the design of the feeding networks of many large street railway undertakings, and in the legislative limitations imposed thereon.

Larger and more powerful cars are continually being adopted, and are run at closer intervals. Traffic stops increase in frequency, necessitating a quicker acceleration in order to maintain the schedule speed, and the rate of consumption of energy per car is greatly increased. The net result of this increased rate of consumption and of the reduced headway is to cause a still greater



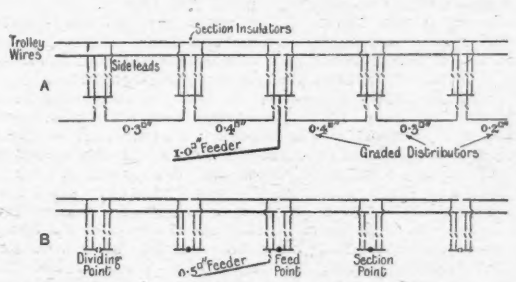
Curve A, KW.-hours per car-mile; Curve B, KW.-hours per ton-mile; Curve C, car-mileage run; Curve D, average weight per car.

FIG. 1.—OPERATING STATISTICS FOR MANCHESTER.

increase in the intensity of electrical loading as expressed in kilowatts per mile. These effects are illustrated by the curves on fig. 1. At Manchester, owing to the small extent of the "city area," the rate of electrical loading at the centre is some 1,500 KW. per mile of route, and the rate of energy consumption of a car is some 38 per cent. greater at the city end than at the suburban end of a route. Special references are made to Chicago, owing to its very heavy loading.

Several of the sub-stations are designed for an ultimate capacity of 18,000 KW., whilst sub-stations of 12,000-KW. capacity are not uncommon. These large stations are interconnected by heavy cables, which generally serve also as feeders.

It is obvious that, under these circumstances, in view of the strict limitation of the line pressure, the governing factor in the feeder designs must, at some stage in the development, change from overheating to pressure drop, and that boosting must ultimately be resorted to. As the intensity of loading increases, special



A, British Standard with side leads and distributors (Birmingham); B, British Standard with side leads and simple feeders, (Manchester).

FIG. 2.—METHODS OF POSITIVE FEEDING.

means become necessary in order to maintain the rail drop at a sufficiently low value, and negative boosters must ultimately be adopted.

With light loading and few supply stations the system of feeding illustrated in fig. 2, A, is generally employed, and consists of feeders supported by distributors, which may or may not be graded in size according to the nature of the load variation and to the special duties which they may be required to fulfil. With a large number of supply stations, as at Manchester and Liverpool, the simple feeder system shown in fig. 2, B, is employed, since, even with the short lengths of feeding section available, with economical distribution through the trolley wires alone the feed points are nearer to the stations than to each other. As the intensity of electrical loading increases, the length of feeding section rapidly diminishes, and with very heavy loading, owing to the reluctance of engineers to employ feeders much larger than 1 sq. in. in cross-section, the simple feeder system of feeding is universally adopted, although, in many cases, with modifications, as at Chicago, where the feeder is continued throughout the whole length of the section and tapped on to the trolley wires at intervals of from three to six spans, the conductivity of the trolley wires being ignored in the design.

The conductivity of the trolley wires is a matter of importance with the feeding system illustrated in fig. 2, B, and at Manchester their section is increased, on renewal, according to the distance between feeders and to the intensity of loading, this being a temporary provision until such time as installation of additional feeders is justified by the increased intensity of loading, the rate of consumption of energy being reduced by this and similar means as shown by the shaded area in fig. 1.

Several feeders are often operated in parallel for the purpose of preventing too frequent opening of the circuit breakers controlling very heavily loaded sections; and, even with very short sections, it is observed that, owing to the relatively high conductivity of the feeders as compared with that of the trolley wires, the feeders do not share the load equally, the centre of gravity of the load moving over a range of quite half the length of the section. As the whole of the copper must be fully utilised, this has led to the use of heavy feeders with several short sub-feeders radiating to the adjacent feed points. This method is becoming very common, more especially for the feeding of complicated networks. It is equivalent to the installation of equalising cables between the feeders.

Little relief can be afforded long feeders by over-compounding, as the permissible pressure rise at the bus-bar is limited by the pressure rise which may be allowed at the feed points of the shorter feeders, and this should not exceed 10 per cent. If a pressure drop materially in excess of 10 per cent. is, for economical design, required in the long feeders, therefore, it becomes necessary to employ separate positive boosters.

It is unsafe to operate a group of separate feeders from a common booster owing to the risk of abnormal pressure rise at the feed point of a temporarily lightly loaded section, and although, by parallel operation of the feeders, this risk may be avoided, the practice leads to unequal distribution of the load amongst the feeders, the shorter ones being overloaded. For satisfactory operation, therefore, a separate booster ought to be installed in each long and heavily loaded feeder, and with the heavy loading under consideration this would often be practicable. In order, however, to avoid the installation of a large number of boosters of varying capacity the authors suggest that advantage be taken of the method already described of employing main feeders, each having several short sub-feeders. The arrangement is illustrated in fig. 3, and the pressure drop in the main feeder alone would be compensated by the booster, so that the sub-feeder bus-bar would be maintained at a constant potential, the design of the sub-feeders being governed by considerations of overheating alone, and their load fluctuations not materially affecting the pressures at the feed points.

Automatic circuit-breakers with tell-tale indicators at the generating station, whence they could, if desirable, be operated by

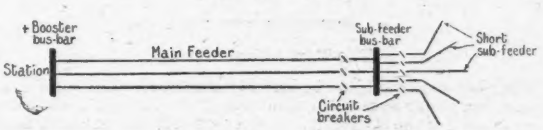


FIG. 3.—SYSTEM OF FEEDING BY SUB-FEEDERS, WITH MAIN FEEDER ONLY COMPENSATED FOR PRESSURE DROP.

remote control, might be installed as shown in order to confine the area affected by a feeder breakdown, and would immediately localise the fault.

The general method of negative feeding is by means of separate feeders, as illustrated by fig. 4. It is impossible mechanically to divide the rails into definite feeding sections as is done in the case of the "line," and all negative feeders from any station must be operated in parallel, the difficulties encountered arising from the resulting lack of exact control of the load distribution in the rails. The conditions are exactly the reverse of those applying to the parallel operation of positive feeders, the conductivity of the four rails of a double track being equal to that of some 4 sq. in. of copper, and hence greatly superior to that of any individual negative feeder. It follows, therefore, that with light loading the amounts of current returning by the respective feeders, if of the same size, will be almost inversely proportional to their lengths, and in order to compel the longer feeders to do their duty they are in some cases made heavier than the shorter ones. In other cases resistance is inserted in the shorter feeders.

However carefully the negative feed points may be selected, the distribution of the return current amongst the feeders is, with very heavy loading, to a great extent governed by the nature of the load distribution, and there cannot be, without excessive outlay in copper, more than one point in the track on each side of the supply station at which there is no current flow, *i.e.*, the rails on each side of the station cannot be divided into more than two feeding sections in which the directions of current flow are mutually opposed, the direction near the station being outwards from it. It is merely a question of the balance of potential following Kirchhoff's laws. The balance point between the two sections can, for fixed loading conditions, be moved farther from the station by increasing the resistance of the shorter negative feeders or by reducing that of the longer ones, and *vice versâ*, but the extent to which, with heavy loading, this can be done, is limited by the pressure loss in the feeders, since the latter alternative is too expensive in copper. For a given length of track with increasing loading the maximum permissible rail drop is ultimately attained when copper must be provided to carry any additional current, and as this copper is operated at a very low current density, its use is very uneconomical.

At Chicago, the 129-lb. rails are reinforced by bare copper cable, in increasing section from 500,000 cm. (0·3927 sq. in.) on the outskirts of the sub-station area to 10,000,000 cm. (7·854 sq. in.) in the neighbourhood of the station, and even with this great outlay there is much electrolytic trouble. The direction of flow is uninterrupted, and if the bonds were cut and the cables separated, the longer ones would bring back more current.

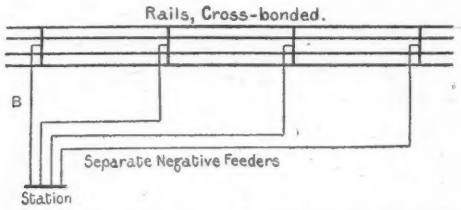


FIG. 4.—METHOD OF NEGATIVE FEEDING ON BRITISH STREET RAILWAYS.

By the use of negative boosters the track may be divided into definite feeding sections almost as perfectly as is the line, and the flow of current in the rails may be controlled in a manner which is almost ideal; but in the few cases in which negative boosters are in use, this has not been done. No definite principle has been adopted, the boosters serving merely as a means of compelling long negative feeders to do their duty without excessive outlay in copper, the principles underlying the application being the same as in positive boosting.

Thus, Glasgow has a negative booster mounted on the shaft of each rotary converter at the sub-stations, and provision is made, as at Sheffield, for switching any booster on to any one of the long negative feeders, or on to a group of long negatives. At Glasgow and Sheffield the negative boosters are excited from positive feeders, but at Leeds there is a large negative booster, capable of being switched on to a group of long negative feeders, excited from a shorter negative feeder, whilst several smaller boosters, used on occasions of heavy traffic, are excited from positive feeders. A negative booster has been in use for some time at Birmingham in order to maintain the feed point on a route served by a long negative feeder at the same potential as that on another route fed by a shorter negative from the same station, whilst the authors know of no case of the use of negative boosters in America, and of only two cases on the Continent.

(To be continued.)

The Turbo-Converter.

THE paper on this subject, by MR. F. CREEDY, of which an abstract was given in our issue of November 8th, 1912, p. 765, was read before the meeting of the SCOTTISH SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS, at Edinburgh, on December 10th.

PROF. BAILEY (Edinburgh) said he took it that with the contrivance they required plant of, say, 1,000 KW. to turn out 500 KW. of power. That was a serious matter, and could only be allowed if they could not work the commutating machine at all. He could not see where this elaborate arrangement could be more satisfactory than simple mechanical gearing. It cost a great deal more and must be distinctly less efficient. Mechanical gearing would run up to 95 per cent. efficiency in large sizes at least, and this machine could not manage that; 92 or 93 per cent. would be the greatest that the induction generator would reach. He gathered that any suitable ratio could be used, and it might have particular applications in certain cases, although he did not see its application for ordinary central station work, where they wanted to run a D.C. machine at a lower speed than the turbine speed. He commended the introduction of the squirrel-cage motor and the application of the spinner idea.

MR. J. A. ROBERTSON asked Mr. Creedy for the combined efficiency of the set. He would not agree with the author in describing the direct-current turbo-generator as a mechanical monstrosity. A great change has taken place in the design of these machines, and he had seen a 1,000-KW. D.C. machine with carbon brushes, which had been running for about two years without the brushes having to be renewed. If they could get a D.C. turbo-generator to work satisfactorily, it would be preferable to this complicated design. Looking at the matter from the commercial point of view, he pointed out that they very rarely in present practice required D.C. in the central station. Modern practice was tending towards large generating units, and the transmission of energy in large quantities, which meant high-pressure transmission, and they were all agreed that the only practicable method of doing this at all was the three-phase A.C. system. He had found in recent years that remarkable efficiency could be obtained in generating with A.C. and utilising the rotary or motor-converter in sub-stations. As for the three-wire system, he thought the figures given by Mr. Creedy were better than anything that had been got from the usual arrangement of tapping a neutral point in a transformer, and carrying it through to the middle wire of the D.C. system, and quite lately he had adopted the expedient of putting in automatic reversible boosters on the end of the rotary shaft; as one side or the other was out of balance, they found this gave good compensation for the drop in voltage.

MR. F. A. NEWINGTON (Edinburgh) thought the arrangement would be more reliable for large sizes than mechanical gearing. He did not see how they could get a reliable machine with cut gearing to run at 3,000 or 4,000 revolutions per minute, while he would not agree with Mr. Robertson that there was no use for D.C. plant in large power houses, it seemed that they would be driven into the adoption of A.C. simply because of commutator troubles. It was not the system, but the plant that was at fault.

MR. BUNTING (Edinburgh) asked if the actual machine had been constructed of any particular size.

MR. WILFRID L. SPENCE (Edinburgh) said he saw the greatest difficulties with the proposed bearings, and an almost insuperable difficulty in keeping them oiled. They got a reduction of the overhang in one of the diagrams submitted, but they also got the ends of the bearings right into the centre of the electrical windings. The spinner ideas were, commercially speaking, almost impossible. He could get mechanical gearing to work well at high speeds, and this was simply due to perfection of cutting and lubrication.

MR. SAM MAVOR (Glasgow) said it might interest Mr. Creedy and others to know that his firm (Messrs. Mavor & Coulson) were in communication at present with one of the most experienced builders of large marine turbines on the Clyde, with special reference to mechanical defects involved in the spinner motor, especially in large sizes, and those engineers had said most emphatically that they saw no insuperable difficulty in the mechanical design of the spinner motor in large sizes. They considered that they had overcome difficulties much greater.

The CHAIRMAN said he had seen a good deal of trouble with commutators at high speeds.

In the course of his reply, MR. CREEDY pointed out that the device was got up on purpose to avoid a machine of 1,000-KW. capacity to give a 500-KW. result. This was the result they got if they used an A.C. generator to drive a rotary converter. The arrangement he had described bore the same relation to that as the motor-converter bore to the motor-generator. The capacity of the set was the sum of the capacity of the elements, not twice that. As to the three-wire system, Mr. Robertson had answered the question about the compounding of it, for which there was no way except by a booster. He considered the percentage of drop quite reasonable. He agreed with Mr. Robertson that the thing to do was to abolish D.C., but failing that, he thought there was some use for that apparatus. He had not got any definite figures to offer on efficiency. He was glad to hear Mr. Mavor's statement that large marine turbine builders saw no insuperable difficulty in the spinner idea. In this respect he thought mechanical engineers less conservative than their electrical brethren, who sometimes failed to admit the utility of a design which mechanical engineers were familiar with. The apparatus described was free from the possibility of gear stripping in the case of sudden short-circuits, and while the gearing might be less expensive than the induction generator, they saved on the converter, which was cheaper than the generator.

Modern Methods of Electric Wiring.

ON December 11th MR. FRANK BROADBENT, M.I.E.E., read a paper on this subject before the ASSOCIATION OF ENGINEERS-IN-CHARGE. Referring to the earlier methods, the author pointed out that in 1874 a Canadian patent of Woodward described both the tree system and the distribution system of wiring, on which all modern developments were based. For interior wiring, he said, the distribution system was now practically universal in this country; in rare cases a pair of conductors were run to each individual light, and in motor installations this system was undoubtedly the best, as it facilitated testing and caused the least possible derangement in the event of the motor being overloaded or faulty. In large installations subdivision was necessary, carrying the distribution system a stage further; from the main switchboard feeders were run to main distribution boxes, and from these in turn sub-distribution boxes were fed, followed by smaller sub-boxes, if necessary, before the branches were run to the various groups of lights. In planning an installation, it was often the best plan to work back from the lighting points to the main switchboard, rather than *vice versâ*. The Institution Wiring Rules, which were now generally recognised as the minimum standard to which good electrical installation work should conform, prescribed a limit of 600 watts for a branch circuit and fuse, but even this small value, with modern lamps, represented more than one might care to control by one fuse. In public buildings it might be necessary to run two circuits where one would suffice from the point of view of current-carrying capacity, in order to prevent the possibility of plunging a room in darkness through the failure of one fuse. The principal circuits might, with advantage, be limited to 5,000 watts, fixing the number of ways in the sub-distribution boxes at 10 or 12. The main distribution boxes should not control more than about six circuits each. The largest installation thus consisted of a number of small installations linked up to a central distribution point. The same principles applied to motor installations, treating each motor like a group of lights.

Joints in wiring were to be avoided, looping being preferable, within limits; but the latter was frequently carried to excess, causing unnecessary expense, complication and risk, as the wires were not really looped in actual practice, but were cut and held together in the terminals, and the mechanical connections thus made were not always above reproach.

While the Institution rules allowed small wires to be run at current densities up to thousands of amperes per square inch, on the basis of temperature rise alone, it was not possible to use such high densities unless the length of conductor was very short, as the voltage drop would be excessive. For lighting circuits a drop of 2 or 3 per cent. might be allowed, but for power circuits the current density was the only limit. Not more than half the drop

should take place between the main switchboard and the distribution boxes.

Regarding the quality of conductors employed, owing to the fact that the smaller cables of a given grade had a higher insulation resistance than the larger ones, it was possible, when a specification called for a given minimum insulation resistance, as in the Phœnix Rules, to use cables of different grades of insulation on a job without any of them falling below the prescribed minimum. On the other hand, the Institution Rule No. 41 made it clear that for all work up to 250 volts the cables must be of at least the 600-megohm grade, in which the smallest cables had an insulation resistance of 1,250 megohms per mile. The grades referred to were those of the Cable-Makers' Association, and the "Association" label was a hall-mark as to quality. The "non-Association" quality was listed as a 600-megohm class, and nothing above 600 appeared to be guaranteed in any size. The only simple test of rubber insulation was the stretching test, and the only safe practice to use well-known British manufactures.

For feeders and main circuits, paper or fibre-insulated lead-sheathed cables might be used with advantage.

For low pressures and in dry situations, wood casing had done very good service, and even in damp places it had been extensively and successfully used when treated inside and out with waterproof paint or varnish. The chief objection to it was its combustible nature. For moist places, good lead-covered cable, properly installed, was hard to beat, but it must be properly supported throughout its length. It must never be used in tanneries or breweries, or underground near the roots of trees, unless specially protected. It could be run along dry brickwork with comparative safety, but not along a damp wall or in contact with moist lime. The creeping of the lead sheathing must be guarded against by continuous support, and in the case of vertical runs, lugs should be soldered to the sheath. Lead-covered cables must not be laid in contact with iron.

For factory wiring and public buildings, screwed barrel was very largely used, and, when well done, made a sound engineering job. Slip socket conduit was not recommended. The choice of system for use in moisture-laden atmospheres was a difficult question; pipes tended to become water-logged, with disastrous consequences. For such cases open work on insulators was preferable, the vertical runs to switch positions being in conduit sealed with compound at the top and open at the bottom. Electrically speaking, there was no such thing as a watertight piping system.

Using screwed piping installations in "fireproof" buildings, the author had never had any trouble due to condensation in the pipes, owing to the fact that he insisted on a clear space being left between the pipes and the walls or ceilings. The piping must be metallically continuous and earthed, and the joints must not be made with red or white lead, but the screw threads should be painted with aluminium paint and put together whilst wet. The earth connection was often quite inadequately performed. After filing a clean place on the conduit, it should be painted with aluminium paint, and a substantial earthing grip should be attached to the prepared place. The same method should be applied to the waterpipe which formed the earth. Serrated earth grips made a very good contact.

All switch boxes, motors and other metal must be earthed, but manufacturers, with few exceptions, never fully appreciated the fact.

"Thus we have small ironclad switches and fuses with two smooth inlets and outlets for the cables, instead of one tapped boss top and bottom to receive a screwed pipe. When only one hole is provided, it is in rare cases that sufficient room is provided to permit of leading the cables into the terminals without dangerous cramping. In some designs, even by the most reputable firms, the iron cases are split across the cable inlets, which are provided with porcelain insulators to pass the cables through. This involves stopping off the pipes on each side of such boxes, bushing the ends, attaching earthing clips to them, and connecting these to the boxes by wires in any convenient way, which is generally by twisting them under the heads of the fixing screws. It is a tinker's job when all is done. Again, motor makers turn out motors intended for 400-volt circuits without terminal boxes. In some cases they adopt the hateful American practice of leaving tailpieces sticking out with brass sweating sockets on the ends. How in this world they expect a wireman to connect his cables up to these, and at the same time maintain metallic continuity between the pipework and the motor case, in accordance with Home Office requirements, is known only to themselves. I am afraid I speak rather feelingly on these points, as I have seen so much of it, and cannot help sympathising with the wiremen and erectors, who get thoroughly disheartened when, after taking special pains to maintain metallic continuity throughout the piping system, they find that the fittings supplied have been designed in entire disregard of all regulations, and that they have to make a patchwork job at the finish.

"One is tempted to go on to criticise those fittings, and they are legion, which are so designed as to make it impossible to wire them without stripping the conductors of their protective coverings; to comment on those distribution switch and fuse-boxes which need to be entirely dismantled in order to erect them; to point out the absurdity of placing terminal screws in such positions that it is impossible to apply a screwdriver to them, and so on."

Wood distribution boxes were preferable for domestic purposes; the continuity of the piping could be preserved by fixing iron plates top and bottom to receive the pipes, and bonding them together. The common practice of connecting fuses directly to the bus-bars in the boxes prevented them from being made dead without making the box dead, when replacing a fuse. When knife switches were used with the current passing through the hinges, the live ends of the cables must be connected to the clip contacts and not to the hinges, otherwise the blades were alive when the switches were off.

For dry interiors the Stannos and Henley systems of wiring were finding wide application, as they made a much neater job than stee conduit for surface work. The St. Helens Cab-tire sheathing was also useful for specially bad situations.

THE PHYSICAL SOCIETY EXHIBITION.

(*Continued from Vol.* 71, *page* 1084.)

Robt. W. Paul.

A large number of instruments were exhibited by Mr. Robt. W. Paul, most of which were of quite recent design.

We illustrate (fig. 3) a sensitive microammeter, indicating one-fifth of a microampere and arranged with suitable internal resistances and shunts for measuring pressures from ·02 to 600 volts and insulations up to 3,000 megohms. The shunt switch is fitted with a clutch which prevents the instrument from being closed unless

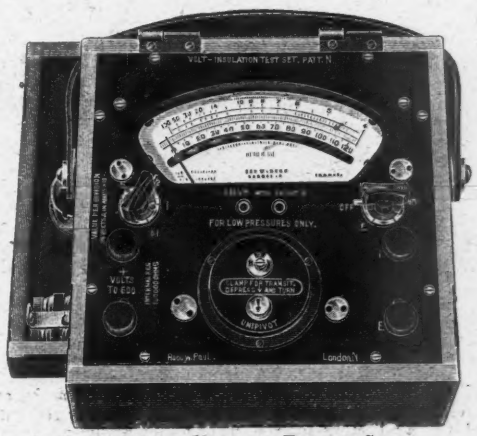


FIG. 3.—PAUL UNIPIVOT TESTING SET.

the switch is left in the least sensitive position, and connection may be made directly to the galvanometer by means of detachable plugs. This test set has advantages in respect of simplicity and compactness of design.

A still simpler form of testing set was shown (fig. 4) no larger than a lineman's detector; it consists of a Unipivot with two scales, one of which is graduated in megohms. This galvano-

FIG. 4.—UNIPIVOT DETECTOR.

meter is a separate unit, and can be detached for other tests when required. When it is in position in the set, any insulation resistance connected to the terminals I, E, is read off directly on the scale.

Another exhibit was the Unipivot series of D.C. millivoltmeters adapted for the measurement of high-frequency and alternating current by the addition of a heater, which is crossed at its centre by a small thermo-junction; the alternating current being passed

through the heater, the thermo-junction indicates the value of the high-frequency current or pressure direct on a square-law scale. The device is enclosed in an exhausted bulb which, by means of suitable resistances put up in the same case, can be standardised, and in that form is called a thermal converter. These thermal converters may be fitted with interchangeable multipliers, so that current or pressure up to any value may be read by a system already well known in connection with the D.C. instruments.

Dynamometer Unipivots have now been developed as single or multirange ammeters, voltmeters or wattmeters, in a form convenient for portable precision instruments for alternating current of frequencies up to 400 per second.

An improved dynamometer was shown, which was recently invented by Mr. J. T. Irwin, and contains an astatic moving coil, whereby errors due to extraneous fields, even of considerable

Fig. 5.—Portable Bridge.

intensity, are eliminated. This dynamometer is made as an ammeter, voltmeter or wattmeter in a convenient portable form, and also as a reflecting instrument of high sensitivity. It can be set up as a standard for calibrating A.C. apparatus.

Among numerous improvements in resistance measuring apparatus may be mentioned an extremely compact and portable self-contained Wheatstone bridge (fig. 5), weighing a little over 2 lb., and containing four decade sets of coils, together with multiplying ratios, which are put into action by depressing one of three keys. These keys are arranged so that the small battery, which is enclosed in the set, shall not be unnecessarily exhausted. On pressing the key lightly a resistance is put in the battery circuit, and thus the sensitivity of the bridge is reduced. When the balance is nearly obtained the key is pressed harder, and the resistance is then short-circuited, so that the full sensitivity is obtained. The battery can be easily renewed, as it is of a kind kept by most dealers in electrical

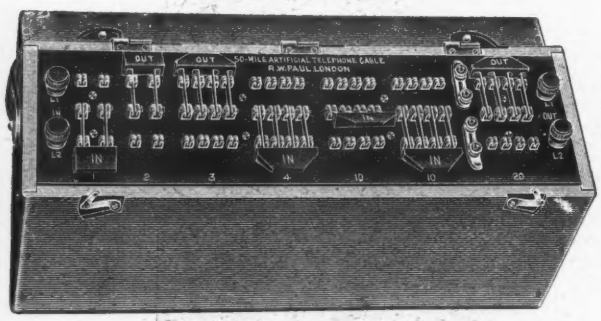


Fig. 6.—Artificial Telephone Cable.

novelties. As in the case of the insulation meter, the galvanometer can be detached and put into a leather case for pocket use.

A number of new types of electrostatic voltmeters and pyrometers were shown, as well as some new instruments of the Harris ohmmeter class, the working parts of which are similar to those of the Omega described in our issue of October 18th last. Of these ohmmeters, one was exhibited having separate ranges and reading from 1 microhm upwards.

Mr. Campbell's apparatus for high-frequency measurement of inductance and capacity was shown in action, the latter measurement being made by the Carey Foster method, which gives direct readings from 1 micro-microfarad up to 10 microfarads.

Important improvements have been made in the string galvanometer, which has now been reduced to its simplest and most accessible form, the design being based on that of Dr. H. S. Souttar; in this instrument the string consists of a glass tube about ·002 mm. diameter, and the instrument can be used with a reading microscope, or by projecting curves on a travelling photographic plate for recording wireless telegraph signals and for physiological work.

The Irwin Optiphone was shown recording speech waves, and among other telephone measuring apparatus was a cross-talk meter and an artificial telephone cable. The latter, which we illustrate (fig. 6), was designed by Mr. B. S. Cohen. Each section can be separately removed, it being shielded from the remainder by aluminium plates. Each section is thrown into action by operating a four-pole switch, thus obviating the necessity for the manipulation of a number of switches or plugs, and rendering speedy adjustment possible.

H. Tinsley & Co.

The principal features of this firm's exhibit were the various instruments devised by Dr. C. V. Drysdale for alternating-current work. The A.C. potentiometer which has been evolved by their co-operation, for frequencies between 25 and 500 cycles per second, was

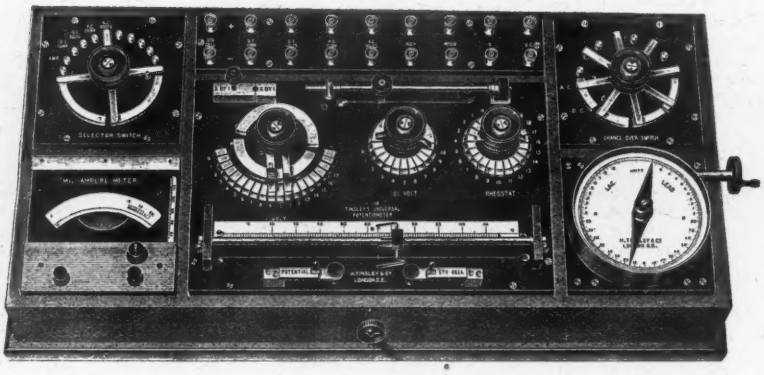


Fig. 7.—Drysdale A.C. Potentiometer.

shown (fig. 7). As the result of five years' work, the readings of this instrument, in its most improved form, are accurate within 0·1 per cent., and the phase angles within 0·1 of a degree; the phase-shifting transformer now gives a pure sine wave at all angles, in spite of the presence of iron, the harmonics being almost entirely eliminated. This instrument fills the gap in alternating-current work corresponding to the indispensable potentiometer in D.C. work, and we understand that it is being adopted by large electricity works for the measurement of alternating currents up to thousands of amperes, in the same way as the D.C. potentiometer.

A high-frequency A.C. potentiometer for telephonic research was also shown, having a range up to 2,000 cycles per second, and, in conjunction with this, an artificial telephone line, 100 miles long, was exhibited. One of the most interesting features of the exhibit was a diagram plotted from readings obtained with this instrument over a 50-mile telephone cable; the attenuation of this line at 1,000 cycles per second was enormous, but the readings were obtained on the potentiometer with ease and certainty; the effect of the inductance of the receiving instrument in compensating for the capacity of the line at the receiving end was clearly demonstrated. The phase displacement in this instance amounted to as much as 360°, as regards the voltage, and the current twist was 376°.

Other exhibits included Dr. Drysdale's stroboscopic slip indicator, the principle of which has been fully described by the author in our pages, and which is the only instrument of its kind that gives by direct reading the percentage slip to within $\frac{1}{20}$th per cent.; standard wattmeters with astatic coils and fields with an accuracy well within 0·1 per cent.; and the Drysdale phase-shifting transformer for meter-testing, a new pattern which is guaranteed to give an absolutely pure sine wave at all phase angles as well as a constant voltage, the phase angle being also guaranteed correct to a fraction of a degree. Many other instruments were contained in this very interesting exhibit.

Harry W. Cox & Co., Ltd.

This firm showed a collection of X-ray apparatus, interrupters, fluorescent screens, &c.

The Edison Storage Battery Co.

Edison accumulators, complete and in parts, were shown by this company.

Elliott Bros.

The latest patterns of the Century testing sets, P.P. dynamometer instruments, and instruments of various types for portable and switchboard use, were shown.

A. Gallenkamp & Co., Ltd.

Furnaces for temperatures up to 1,100° C., of the resistance type, with silica heating surfaces, were the electrical features of this exhibit.

(*To be continued.*)

LEGAL.

OSRAM LAMP CO. *v.* D. SMITH & CO.

IN the Chancery Court on Friday, December 20th, before Mr. Justice Warrington, Mr. Colefax, K.C., on behalf of the Osram Lamp Co., applied for an injunction to restrain Messrs. David Smith and Co., Red Lion Court, Fleet Street, E.C., from dealing in certain electric lamps which were an infringement of two of their patents, namely, No. 23,899 of 1904, and No. 18,622 of 1906.

Counsel stated that defendants had traded in certain electric lamps which they said were made in Dresden, but which the plaintiffs alleged were an infringement of their two patents in the treatment of the filaments. In November the defendants were approached, and 150 lamps which were described as "Goblin" lamps, were purchased, and some of these were handed over to Dr. Oberlander, who analysed them. Others were sent to Sir James Dewar, and an analysis of the filaments convinced both gentlemen that these had been made of tungsten with a compound of binding material, and that the carbon had been removed by the process which was an infringement of the plaintiffs' patents. His Lordship would remember that the whole matter was dealt with in a previous action. So far as the evidence of the defendant was concerned, it amounted to this, that this Dresden company from whom he obtained his lamps had simply informed him that the lamps had been made in a way that was not an infringement of the plaintiffs' patent, and the only other evidence was that of Mr. Bevan, who had stated that in his belief there was another process by which they could extract carbon from the filaments by the use of hydrogen. Counsel read affidavits of the results of the examination of the lamps by Dr. Oberlander and Sir James Dewar, and asked, having regard to these, that an injunction should be granted.

MR. TERRELL, K.C., for the defendants, stated that after the trial of the action to which Mr. Colefax had referred, everyone was particularly anxious that there should be no infringement of these patents, and the defendants had obtained specifications of them and forwarded them to Dresden asking if there would be any infringement of the English patents in connection with the Goblin lamp. In reply he had been assured that they did not infringe these patents in any way. At the trial of the previous action the question raised was whether the carbon was removed physically or chemically, and, of course, after the judgment in that instance, everybody had taken care what method was used. Why should it be presumed that in the present instance moisture had been used? Supposing there were three ways of dealing with filaments; one by using nitrogen, one by using moist hydrogen, and a third by which the carbon could be removed physically by electric current at a high temperature. If his learned friend said that the first two came within his patents, he still had to prove that it had not been done in the third way. That carbon could be taken out of the filament by this means there could be no doubt.

His LORDSHIP said he thought, on the whole, he ought to grant an interlocutory injunction. There had been no evidence at all from the manufacturers of the Goblin lamp as to their process. All he had was a general statement that they did not infringe the patent. A specification of the second patent was sent to the German manufacturers, but it was not said in their answer that they treated their filaments by chemical process purely, and they did treat them with hydrogen. It was just possible that they might treat them with hydrogen in such a way as to expel the carbon physically and not chemically, but that was all, and he thought he ought, on the evidence of Sir James Dewar and Dr. Oberlander, to treat that as being so doubtful that it would be better that he granted an injunction for infringement rather than let the defendants go on selling the lamps, which might possibly be a serious matter for the plaintiffs.

His LORDSHIP granted the injunction accordingly.

DUNDEE TRAMWAY CLAIM.

A PECULIAR point arising out of the working of the Dundee-Monifieth Tramway has been decided by Sheriff Neish. A farmer sued the Dundee, Broughty Ferry and District Tramway Co. for £60 in respect of loss and damage sustained by him through one of the defenders' cars coming in violent contact with a cart and two horses belonging to him. For the company it was contended that the motorman and conductor of the car were at the time of the accident acting as servants of the Dundee Corporation, and the Sheriff finds in fact and in law that they were, and dismisses the action, with expenses to the defenders. His Lordship thinks pursuer's remedy was to sue both the company and the Corporation, and let them fight out the question of liability. He feared, however, the pursuer was now too late to sue the Corporation.

The Numbering of Tramway Routes.—In reference to a decision by the London County Council, on July 30th last, that the routes on the tramways should be numbered, the routes to be indicated by means of numbers fixed to the cars, the Highways Committee recently reported that since that date an improved type of plate, manufactured by VENNER'S SIGNS, LTD., had been brought to their notice. To fit all the cars with this type of plate and the necessary reflector, lamp, &c., would cost about £1,570 more than in the case of the plates originally contemplated. The Committee recommended, and it was agreed, that the plate manufactured by Venner's Signs, Ltd., should be adopted.

BUSINESS NOTES.

Calendars and Diaries.—THE ARMORDUCT MANUFACTURING CO., LTD., of Farringdon Avenue, London, E.C., have sent us a set of refills for their perpetual desk calendar circulated a few years ago. We shall find these refills useful in 1913. The Armorduct Co. has also sent us one of its desk blotting pads which might have been more serviceable if the top pocket border had been just a little quieter. Each sheet of blotting contains a calendar for the year.

THE DIAMOND COAL CUTTER CO., of Wakefield, have prepared a wall calendar with monthly slips for 1913. The design includes a picture of one of their coal-cutting equipments.

From MESSRS. VENNER & CO., of 6, Old Queen Street, Westminster, London, S.W., whose new year souvenirs are always useful, and last well, we have received a handy little key-ring, accompanied by an appropriate folder written in characteristic Venner style. If any of the firm's usual recipients have been inadvertently overlooked, they are asked to notify the fact, and so long as the stock lasts they will prevent disappointment.

MESSRS. ALFRED HERBERT, LTD., of Coventry, have again issued a most serviceable monthly sheet calendar for the New Year, each sheet bearing an art illustration of one of their machine tools, and boldly-printed dates.

THE D.P. BATTERY CO., LTD., have again drawn upon the beauties of the country in which their works are situated for a picture wherewith to adorn their 1913 calendar. A charming view in colour of Water-cum-Jolly on the River Wye, which provides the company's water power, so takes one's interest that the set of small monthly slips is almost lost sight of.

THE HART ACCUMULATOR CO., LTD., of Marshgate Lane, Stratford, London, have once more prepared as a New Year souvenir for their friends a handy desk blotting pad.

From the GENERAL ELECTRIC CO., LTD., of Queen Victoria Street, London, we have received another of their serviceable desk reminder stands, with a set of turn-over engagement slips for the year 1913.

From MESSRS. PIRELLI, LTD., we have received an ingenious hanging or desk perpetual type calendar. Daily and monthly changes are effected by turning a couple of brass knobs, the name of month and date figures being clearly brought out within the circle of a Pirelli tire which stands out quite realistically against a green and blue watery background, with waterfalls and a sky of golden glory beyond.

The insulating varnish department of MR. CHAS. H. BLUME (White Building, Sheffield) will be remembered during 1913 by all who receive their excellent wall calendar, for above the monthly date slips there is a charming reproduction of the well-known picture by Millais in which two boys—Sir Walter Raleigh and another—are under the early spell of tales of the sea and what lies beyond it. Together with the calendar Mr. Blume has also sent us a handy size memoranda and pocket engagement book (one line per day) for the year. A number of useful tables and an "Ocean" insurance coupon are contained therein.

THE SUN ELECTRICAL CO., LTD., of 118 and 120, Charing Cross Road, W.C., have sent to their friends a pocket propelling pencil and case of refills for obvious purposes during 1913. If perchance any pencils have gone astray, a line dropped to the company will at once bring another to take its place.

A calendar of serviceable size and interesting design has been received from the WESTERN ELECTRIC CO., LTD., of Norfolk House, London, W.C. It is suitable either for hanging or for desk use, and has monthly tear-off slips with clear figuring.

MESSRS. THERMIT, LTD., of 27, Martin's Lane, London, W.C., have issued one of their useful pocket note-books with 1913 and 1914 calendars, also a number of pages of descriptive and other matter relating to the Thermit system.

MR. H. A. WESTMANCOTT, electrical contractor, of 280, Goswell Road, London, E.C., has circulated a wall calendar with monthly slips.

A wall calendar in which both the perpetual and the monthly tear-off slip arrangements are employed has been prepared by POPE'S ELECTRIC LAMP CO., and they will send a copy to anybody who may perchance have been overlooked, on receipt of application. "Elasta" wire lamps are, of course, well in evidence in the design.

Friends of MESSRS. FALK, STADELMANN & CO., LTD., 83-87, Farringdon Road, London, E.C., have received an "Efesca" scribbling pad, which, we imagine, will be a very serviceable desk companion for some time to come. Calendars for 1913 and 1914 appear inside the cover, and the pad is of the renewable class. Any of our readers can have one on application to the firm.

MESSRS. NEALE & WILKINSON, LTD., shipping and forwarding agents, 32, St. Mary Axe, London, E.C., have issued a wall card for 1913, showing conveniently a calendar for the entire year, in addition to which there is a block of daily date slips, with bold red figuring. Copies will be sent on application.

THE DUSSEK BITUMEN CO., of Canal Bank, Deptford, London, S.E., have made an excellent improvement in their pocket-book and diary for 1913. This time, instead of the accustomed cover, we have a letter and card case with refill diary (Letts), also an accident insurance coupon.

Concert.—On Saturday next, January 11th, at 7.30 p.m., the St. James' Electric Athletic Club will hold its 12th annual smoking concert at the Pillar Hall, Victoria Station Restaurant.

Book Notices.—*The Practical Electrician's Pocket-Book and Diary for* 1913. Edited by H. T. Crewe, M.I.Mech.E. London: S. Rentell & Co. Price 1s. net.—This well-known pocket-book has been improved by the omission of superfluous matter, and the addition of new sections dealing with coal-cutters, cables, power and lighting installations, wireless telegraph stations, the new Home Office Mining Rules, &c., making a net increase of 44 pages. It is a handy size for the pocket, and contains a vast amount of information useful to the electrician engaged in practical work.

"Poems." By Edmund L. Hill. London: *Electrician* Printing and Publishing Co., Ltd. Price 2s. 6d. net.

"*Bulletin* Mensuel de la Société Belge d'Electriciens." Vol. XXIX, No. 10. October, 1912. Brussels: Emile Bruylant Price 1.75 fr.

"*Bulletin* of the Association des Ingenieurs Electriciens." November, 1912. Liége: The Association. Price 9.50 fr.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXXI, No. 12. December, 1912. New York: The Institute. Price $1.00.

"*Proceedings* of the Physical Society of London." Vol. XXV, Part 1. December 15th, 1912. London: The *Electrician* Printing and Publishing Co., Ltd. Price 4s.

"*Journal* of the Franklin Institute." Vol. CLXXIV, No. 6. December, 1912. Philadelphia, Pa.: The Institute. Price 50 c.

"Fortschritte der Elektrotechnik." By Dr. Karl Strecker. Berlin: Julius Springer. Price M. 14

"School of Mines Quarterly." Vol. XXXIV, No. 1. November, 1912. New York: Columbia University. Price 50 cents.

"Bulletin Scientifique de l'Association des Elèves des Ecoles Spéciales." November, 1912. Liége: The Association. Price 75 cents.

"*Proceedings* of the Engineering Association of New South Wales." Vol. XXVI. (With list of members.) Sydney: The Association.

"*Journal* of the Western Society of Engineers." Vol. XVII, No. 9. November, 1912. Chicago: The Society. Price 60 cents.

"*Bulletin* of the Bureau of Standards." Vol. VIII, Nos. 2 and 3. June and November, 1912. Index to Vol. VII, "Melting Points of Fire Bricks." By C. W. Kanolt. Washington: Government Printing office.

"Boletin de Ingenieros." Vol. III, No. 3. November 16th, 1912. Mexico: Departmento de Ingenieros de la Secretaria de Guerra.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—We have received eight sections of the recently-issued complete catalogue of the B.T.H. lamp and wiring supplies. As the book was fully noticed here at the time, we need only mention the titles of the separately-bound sections:—A. Wiring Accessories (holders, ceiling roses, wall plugs, distribution boxes, &c.); B. Bells, Telephones and Batteries; F. Electric Light Fittings; L. Incandescent Electric Lamps; M. Theatrical Apparatus, Flashers, Signs and Motor-Car Accessories; S. Shades and Reflectors; T. Conduits and Accessories; W. Wires, Cables and Accessories. Each of the sections has a different coloured cover of stiff art paper, and, in order to protect the edges of the inside pages, the covers are of such a size as to overlap the latter.

Messrs. J. Kirby & Co., Alpha Street, Dewsbury Road, Leeds.—Illustrated pamphlet of eight pages relating to water-pressure driven pumping engines and Ramsbottom triple-ram water engines for mining and other purposes; also a four-page list showing and briefly describing their electric outfits for organ-blowing. Prices are stated in some cases.

The Schniewindt Electric Co., 40 and 41, Staniforth Street, Birmingham.—New lists of resistance wires made by the Kratos-Werke Erlau, for whom they are sole agents in this country Nickel-chrome heating wires in all sizes are stocked.

Messrs. National Alloys, Ltd., Altior Foundry, 38, The Hill, Ilford, London, E.—Twenty-four-page catalogue describing their various manufactures, which include "Ivanium" aluminium alloys, "Cupranium" brasses and bronze, "Bear-ring" anti-friction metals, "Altior" manganese, aluminium and phosphor bronze, &c. A table is given of physical properties of metals.

Trade Announcements.—Messrs. Lodge Bros. and Co. have built large offices adjoining their works in Wrentham Street, off the Bristol Road, Birmingham, and during the holidays they removed into them. The change was imperative, owing to business expansion. All communications should be sent to Wrentham Street in future. Telephone No.: "Midland 2200" (two lines). We have received an illustrated leaflet of the "Lodge" sparking plug.

Mr. George E. Piggott, who has for the last 15 years made the subject of elevating a special study, has now associated himself with Messrs. Etchells, Congdon & Muir, Ltd., of Manchester, and will manage their London and South-Eastern Counties business at his present address—24, New Bridge Street, London, E.C. Samples of the various parts of apparatus are on view, including the automatic speed governor and collapsible gates.

Mr. C. Franklin Tubbs has increased his manufacturing accommodation, and taken new premises in Carlton Mills, Leeds, which cover a floor space about four times that of the old workshop. The extension was necessitated by increasing demand for "Nonpareil" apparatus, and prompt delivery of all classes of A.C. switchgear and other specialities will now be ensured. All correspondence should be addressed to 2, Craven Terrace, Carlton Hill, Leeds, as previously.

Mr. P. S. Doherty, of 25, Victoria Street, London, S.W., has been appointed sole British agent for the sale of locomotives manufactured by the Société Anonyme de Saint Léonard, of Liége, and also for railway bridges, points and crossings manufactured by the Société Anonyme du Nord de Liége.

The Armorduct Manufacturing Co., Ltd., are making further large extensions at their Witton Works to cope with the increasing demand for their specialities.

Our Bradford correspondent writes that the Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford, announce their intention to double the capacity of their works, and state that the cause of the necessity of this extension is the success of their specialised system of textile driving."

The Electrical Apparatus Co., Ltd., of Vauxhall Works, South Lambeth Road, London, announce that, owing to the large increase in the sales of E.A.C. high torque electricity meters, and both D.C. and A.C. motor control gear, they are again obliged to arrange for works extensions. A contract has just been entered into for the building of three additional shops, which will principally be devoted to the manufacture of the above apparatus. The present factory, built early in 1911, was a very large extension as compared with the old premises at Milford Works, and now the company have again practically doubled their premises. During the year 1912 they successfully introduced their apparatus abroad, and we understand that their export trade with Canada, South America, Australia, New Zealand, China and Italy is beginning to take on large proportions.

The Electric and Ordnance Accessories Co., Ltd., of Cheston Road, Aston, Birmingham, advise us that they have just appointed Mr. W. Ogden Dayson, of 1, Mount Street, Swansea, to represent them for their electrical manufactures in South Wales. Mr. Dayson succeeds Mr. C. R. Hough, of Swansea, who has given up the agency in order to start business for himself in the Midlands. Mr. Dayson's telephone number is "914 Central."

The Northern Electrical and Ventilating Co., Ltd., removed on 31st ult. from Dale Street, Liverpool, to 6, Williamson Square. New telephone number, "Royal 4364." A large selection of electric light fittings, shades, &c., will be on view in the new showrooms early in the New Year.

New Vulcanised Bitumen Strip.—A new form of vulcanised bitumen strip has just been introduced by Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, E.C., with which a homogeneous joint can be made in the insulation of V.B. cables, the difficulties hitherto met with in making a satisfactory joint having been overcome. The new material, which is called the "Clyde" tape, is of such a nature that the simple process of warming the lapped joint with a blow lamp causes it to become thoroughly adherent and to form a perfectly homogeneous joint. It is supplied in any of the usual widths, from ½ in. upwards, in rolls of about 1 lb., and in three thicknesses, packed in air-tight tins.

For Sale.—The Bristol electricity department has for disposal a 30-ft. electric launch, and a quantity of electrical plant and material. See our advertisement pages in this issue.

Dissolutions and Liquidations.—Light Railways Syndicate, Ltd.—This company, meeting at the offices of the New General Traction Co., Ltd., London, on November 25th and December 2nd, resolved to wind up voluntarily.

International "Z" Lamp Association, Ltd.—This company is winding up voluntarily with Mr. C. Field, Broad Street Avenue, E.C., as liquidator. A meeting of creditors is called for January 6th. Creditors must send in particulars of their debts, &c., by January 31st.

Superheaters, Ltd.—A meeting is called for February 3rd at 19, Southampton Street, London, W.C., to hear an account of the winding up from the liquidator, Mr. G. W. F. Dawes.

Bankruptcy Proceedings.—Wesley Sutton, 62, Dale Street, Liverpool, lately trading in partnership with Samuel Lord and John William Garsden, under the style of the Howe Electrical Engineering Co.—This debtor attended at the Court House, Government Buildings, Victoria Street, Liverpool, last Monday, before Mr. Registrar Howarth, for his public examination. In reply to questions, the debtor disputed the allegation made that he had anything more to do with the books of the firm than Mr. Lord had, so far as investigating the condition of the business was concerned. When he left the partnership, the £100 he received was a figure arrived at by a balance-sheet, and at that time he was not aware that in law he was liable for certain amounts for which he had since been held liable. He attributed the failure of the company to the large amount of money spent on the development of certain patents, out of which they had expected to make their fortunes. From 1876, when he returned to England from America, to 1893, he was engaged in an engine-packing manufacturing business in London, Castleton and Manchester, from which he retired with about £2,000. Later, he had an interest in an "outside" stockbroking business in Manchester, in which he lost considerably. Afterwards he had another business in Birmingham, which he sold for about the same figure as he had given for it, and about 1895 he went to Liverpool and joined the Howe Electrical Engineering Co., into which he paid £300 capital. In October, 1909, that business was sold to a limited company. The case was adjourned, and certain accounts were ordered.

Albert Edward Martin (trading as the Midland Electrical Supply Co.), electrical engineer, 39, Great Charles Street, Birmingham.—January 8th is the last day for the receipt of proofs for dividend. Trustee, Mr. A. S. Cully, 191, Corporation Street, Birmingham.

SAMUEL LORD, director of a limited company, 18, James Street, Liverpool.—Mr. Registrar Howarth also held a sitting at Liverpool last Monday for the public examination of this debtor. Mr. Percy Martin appeared for the debtor, whose statement of affairs showed liabilities amounting to £3,342, and assets estimated at £5 10s., which sum was insufficient to cover the claims of the preferential creditors. Questioned by the Official Receiver, the debtor stated that he had formerly been in partnership with Wesley Sutton, who was his father-in-law. He (Lord) was at present manager of an electrical engineering company at a salary of £3 a week. About 18 years ago he joined two others in partnership under the style of the Howe Electrical Co. He brought in £600, obtained by an advance on a reversionary interest in his father's estate, and later he brought in further capital. About three years later one of the partners retired, and the business, which was carried on at Redcross Street, Liverpool, was continued by himself and Mr. Wesley Sutton, the other partner. At that time a Mr. Garsden was admitted a partner, and a branch of the business was opened at Blackburn. This gentleman also brought in capital. In September, 1909, the partnership assets, with the exception of the outstanding book debts, were sold to a company called the Howe Electrical Engineering Co., Ltd., for £1,200 in cash and £2,400 in shares, but the partnership liabilities were not to be taken over by the limited company. The partnership was dissolved in the following month, and he (the debtor) and Mr. Garsden paid Mr. Sutton £100 as his interest, and by the deed of dissolution agreed to idemnify him against all liabilities in respect of the late partnership. In February, 1911, the limited company went into voluntary liquidation, and part of the assets were acquired by a new company, of which he (the debtor) was now the manager. The debtor was questioned as to various sums borrowed from private persons and as to the overdrafts that were guaranteed at the bank and had been paid by the guarantors. He asserted that he knew very little about the financial affairs of the firm, as he left that mainly to Mr. Sutton, in whom he placed implicit confidence. In regard to the sale to the company, he stated that he knew very little about the figures, nor did he know how various amounts owing by the partnership were treated in the books of the firm. The Registrar ordered the case to stand adjourned, and intimated that the debtor must come prepared to give further information than he had given on the present occasion.

LIGHTING and POWER NOTES.

Argentina.—Referring to the concession question in Buenos Ayres, the *Review of the River Plate* says:—In view of the fact that Messrs. Lacroze Bros. have now applied direct to the municipality for a concession under the same terms as those granted to the Alemana and Italo-Argentino Companies, we do not think that anything further will now be done in connection with this matter. By their application for a concession Messrs. Lacroze evidently do not intend to stand by the rights given them by the Government decree, and, therefore, if they do not adhere to those rights, in our opinion, no other company can claim the privileges established by that decree.

The Italian Argentina Electric Co. has secured, after a lively struggle, its concession to supply the city of Buenos Ayres with electric light. The society has, says *La Lumière Electrique*, a capital of 125 million francs.

Australia.—When the mail left Tasmania the works of the Hydro-Electric Co., Hobart, were about to be temporarily stopped. The explanation given was that more capital was needed to complete the works. "There is no doubt," said Mr. Ewing, one of the local directors of the company, in an interview with a Press man, "that the undertaking was under-capitalised considering the magnitude of the work that was contemplated."

A scheme for generating electricity by utilising the waters of the Yarra has just been under the notice of Mr. Graham, Minister for Agriculture and Water Supply. Power could be obtained from the Yarra between Evelyn and Horse Shoe Bend, 15 miles from Melbourne. A deputation on the subject pointed out to Mr. Graham that the Government should consider this in connection with the proposed electrification of the local railways. The Minister said that the suggestion would be laid before the State Rivers and Water Supply Commission for report.

Baildon.—The U.D.C. has sealed a memorial to the B. of T. applying for a prov. order for electric lighting.

Ballyconnell (County Cavan).—A scheme is on foot for the electric lighting of this village. The matter is in the hands of Messrs. T. M'Govern and T. O'Reilly.

Barking.—Subject to the British Anti-Fouling Composition and Paint Co. guaranteeing a minimum consumption of 30,000 units per annum for a period of five years, the necessary extensions of mains are to be carried out to give the company an increased power supply. The Council's service main is to be extended across the Creek at an estimated cost of £225 to supply the northern outfall works of the L.C.C., subject to a guaranteed minimum revenue of £80 therefrom, plus interest on capital outlay.

Basingstoke.—With reference to the electricity scheme prepared by the borough surveyor, the T.C. has decided to obtain the services of an electrical engineer to report on the matter, and, if necessary, attend at the B. of T. in support of the application for a prov. order.

Bentley (Yorks.).—The Urban District Council has agreed to the suggestion that the Doncaster Corporation should supply electricity to Bentley at similar rates to those in vogue in Doncaster, and subject to arrangements being made between the Corporation and the local colliery company, which at present supplies electricity to certain parts of the Bentley district.

Berwick-on-Tweed.—The scheme of the Electric Supply Co. for a complete electrical installation at the barracks, has been accepted by the military headquarters. Under the scheme the entire premises will be lit by the electric light.

Billericay (Essex).—The R.D.C. has decided to have the electric light installed at the new hospital, at an estimated cost of £300, instead of purchasing a petrol air gas plant. The architect, Mr. Bird, has been instructed to obtain tenders.

Bridlington.—The T.C. has referred back to the Electricity Committee for further consideration a recommendation to apply to the B. of T. for consent to supply current outside the borough.

Brighton.—The engineer has been authorised to experiment with series high candle-power metal lamps for street lighting in place of series arc lighting.

It has been agreed to give the Brighton Railway a supply for lighting purposes on payment of £3 per KW. installed lighting demand per annum in addition to the charge registered through the power meter.

Buxton.—The U.D.C., with the idea of obtaining new consumers, has decided to distribute 1,000 circulars, which are to be followed up by a personal call. Sample radiators and other electrical appliances are to be fixed at the engineer's office for inspection by consumers.

The Council has decided to extend the mains to Buxton College, the necessary guarantee to meet interest on the outlay having been given.

Canada.—The operation of the Winnipeg electrical plant gives ample ground for hope that a 3 c. per KW.-hour rate may be established in that city during the next few months. The profit for the month of November, under the present low rates—about the lowest in Canada—was $10,000. Prof. L. A. Herdt submitted to the Board of Control his recommendation for the erection of a second transmission line to Point Du Bois, adding two units to the plant there and enlarging the facilities at the McPhilips Street substation. The whole project would cost $700,000, and would protect the city against all trouble that might occur.

Old Quebec City is rapidly becoming the centre of hydro-electric development. The Quebec Light, Heat and Power Co. had the field almost to itself up to a short time ago, but lately two new hydro-electric companies entered the field. The Stadacona Hydraulic Co. will be supplying energy about the middle of 1913, with some 10,000 H.P., practically all of which has been disposed of.

SASKATCHEWAN.—Mr. George Harrison, manager of the Saskatchewan Ironworks, states that there are about 10 million tons of good steam coal accessible at the Lake of the Rivers, and prophesies that, in due time, a great power station will be erected there to supply current to Regina, Moose Jaw and smaller towns. The Legislature has received the report of Mr. Wynn-Roberts on the feasibility of developing power at the Souri Valley coalfields.

Castle Eden.—The B. of T. has been applied to by the Cleveland and Durham County Electric Power Co. for consent to erect overhead mains at Castle Eden and Parklands, for the supply of current under the Acts of 1901 and 1903, at a pressure of 440 volts.

Chile.—Plans submitted for the establishment of an electric lighting installation in the city of Ancud have been approved.

Cobham.—The Epsom R.D.C. has declined the offer of the Leatherhead Electricity Co. to install electrically-worked pumps at the Cobham sewage works.

Colne.—Under the Colne Corporation Bill of 1913, powers are being sought to extend the area of supply of electricity, so as to include the districts of Trawden and Foulridge.

Continental Notes.—AUSTRIA.—Plans are being prepared for the establishment at Faal a. d. Drau, Styria, of what is expected to be the largest electricity generating station in Austria and Hungary. The Steiermarkische Electricitäts Gesellschaft is interested in the new undertaking.

FRANCE.—A company has lately been formed at Roisel (Somme) with a capital of £8,000, and the title La Société Co-operative d'Electricité du Secteur de Roisel, "to facilitate the agricultural industry by the supply of electrical energy for all purposes."

ITALY.—Under the auspices of the Societa A.E.G. Thomson-Houston, of Milan, and a number of banks, a company has just been formed in Brussels with a capital of £60,000, to acquire an interest in electric tramway, light railway and electricity supply undertakings in Italy.

The new water-power generating station on the River Lima, belonging to the Societa Ligure-Toscane d'Elettricita has recently been completed, two 3,200-H.P. sets of turbines and dynamos being now in operation and connected up to the company's distributing plants at Lucques, Leghorn, Pisa, Viareggio and Pescia. A new 1,000-H.P. Diesel engine has also been installed at the station at Lucques and a new 2,000-KW. turbine and generator are being installed at the Leghorn plant. In addition, plans have been completed for a new generating station at Le Serchio.

RUSSIA.—A company has lately been formed at Bjalistock with a capital of 2,000,000 roubles and the title Die Bjalistocker Electricitäts Gesellschaft, to carry on the central electric ligting station which has been established in the town by the Deutsche Gesellschaft für Electrische Unternehmungen.

In order to meet the increasing demand for current, it has been found necessary to order a third gas engine and dynamo for the electrical power station in connection with the works of the Société Metallurgique Russo-Belge. When the new set is installed the plant will have a capacity of 11,000 H.P.

Darlington.—The Electricity Committee of the T.C. has adopted the recommendation of the engineer (Mr. J. R. P. Lunn) to carry out extensions to the electricity works, at an estimated cost of £10,790, and also to apply for loans of £8,000 for mains and services, and £1,500 for static transformers, for three years.

Devizes.—The T.C. has deferred until February consideration of an electricity scheme for the town submitted by a London firm.

Edinburgh.—The Inspector of Cleaning and Lighting for the city, after remarking on the efficiency of the street lighting, states that among the factors which have contributed to the present satisfactory condition of affairs may be said to be the electric lighting of the tramway routes, the erection of lamps on the islands at the car stopping places and the lighting of the garden side of Princes Street. The total lighting expenditure was £44,591.

Epsom.—The R.D.C. has appointed a Committee to consider the application of the Leatherhead and District Electricity Co. for powers to supply current in the parishes of Stoke, Cobham, Great Bookham and Little Bookham.

Fareham.—The accounts, just issued, of the Council's electric undertaking for the year ended March 31st last, show a revenue of £2,428, and gross profit of £1,387, with which to meet interest and sinking fund payments amounting to £1,426. The deficit of £39 was made good from the reserve fund. Altogether 103,996 units were sold, and the maximum load was 86 KW.

Farnworth.—During the last two months the electric lighting of the main streets has been undergoing complete alterations. After exhaustive tests and experiments, it has been decided to adopt two 300-C.P. Osram drawn-wire lamps of 220 volts, in place of each of the Brockie-Pell 10-ampere arc lamps formerly used, and to fix them to the same poles by means of a two-armed bracket having a projection of some 36 in. from the pole, and fastened to it by cast-iron clamps. The lamps are now arranged at a height of 20 ft. centre of the lamp to ground, and are provided with suitable reflectors. The whole lighting scheme has been designed by Mr. Hutchinson, the engineer, and all the former feeders have been utilised.

Glasgow.—The T.C. has agreed to the proposal of the Electricity Committee to give very large supplies of power to Messrs. Beardmore & Co., Fairfield Shipbuilding Co., Messrs. Collins and Co., Messrs. Braby & Co., and other firms, on the basis of a fixed charge per KW. per annum, to cover charges plus a low-running cost charge, in lieu of a charge per unit. In connection with those and other applications a report was recently presented by Mr. W. W. Lackie, the chief engineer, in which he pointed out the maximum demand on the generating stations this winter had, so far, been 28,000 KW. (37,000 H.P.). This was the figure he estimated it would be in his report of September, 1912, and it was the maximum load the stations were capable of meeting. It was, therefore, absolutely necessary to put on order now, generating plant, not only for the winter of 1913-14, but for the winter of 1914-15, as the new works at Dalmarnock might not be available for the winter of 1914-15. The plant now proposed to be ordered would be installed in one of the existing generating stations and removed later to the Dalmarnock works. They already had two units of 4,000 KW. each, running at 750 R.P.M., but he recommended the T.C. to purchase the largest units of plant commercially available, running at 1,500 R.P.M., which would be found to be 7,500 KW. With a unit of this size they would get the lowest price per KW. of plant, and the maximum economy in steam and coal consumption. Quotations for two such units of plant should be got in at once, as the manufacturers were asking 12 months for the manufacture and delivery of such units, and the demand during the winter of 1913-14 would be at least 31,500 KW., and during the winter of 1914-15 at least 35,000 KW. These figures were exclusive of the idea of shutting down the steam plant at the Govan and Partick electricity works, and these works would continue to be called upon to meet their peak load with their own steam plant. The report was approved, and the engineer instructed to prepare the necessary schedules and specifications.

The T.C. has also approved of application for the consent of the Secretary for Scotland to borrow a further sum of £500,000 for the execution of capital works, which would raise the sum borrowed for that purpose to £2,500,000.

A deputation from the Birmingham Corporation is to make a tour of inspection of the Corporation electricity works and the power stations.

Harrogate.—The T.C. proposes to open a showroom, in which to exhibit and demonstrate the utility of electrical apparatus, in Swan Road. The B. of T. has been applied to for permission for the Council to supply current to premises outside the borough area.

Herne Bay.—The U.D.C. has adopted electric power for pumping purposes, and has entered into a seven years' agreement with Messrs. A. E. Hunt & Sons, for a supply of energy at 3d. per unit.

Hoyland (near Barnsley).—The U.D.C. has been recommended by the Lighting Committee to defer for six months consideration of the question of lighting the township by electricity.

Japan.—One of the recommendations of the Special Committee of the Industrial Investigation Commission, which is at present holding an inquiry in Tokio as to the best means to be adopted for the encouragement of domestic industries, is that "the utilisation of hydraulic electric power should be carried to the furthest limits."

Leeds.—There is a proposal to extend the Whitehall Road Electricity Works, and a committee has been appointed to obtain the advice of a consulting electrical engineer. Mr. C. N. Hefford has been appointed temporarily as engineer of the electricity works.

Liverpool.—A large extension building has been opened by the *Daily Post and Echo* newspaper, in which, as in the old building, the plant is electrically driven. With a view to safeguarding the production of the paper, two Mirrlees-Diesel engines coupled to Crompton generators have been installed in the basement, as a standby to the Corporation supply which is normally used.

London.—POPLAR.—The Electricity Committee reports having had under consideration the subject of the relationship of electric lighting contractors to the Council's undertaking. Contractors now canvass for custom for wiring and fittings, the work being carried out by the Council's staff, but as the Committee feels that the contractors should be encouraged to assist the undertaking by canvassing without the fear of losing work in this way, it has decided to place some orders with the contractors, to be carried out under the supervision of the department, for a period of three months, provided that all materials shall be obtained from the department; that the contractors work to a price list; add for labour and profit; pay Trade Union rates of wages, and that the acceptance of any estimate shall be at the discretion of the department. The question of lighting side streets is also under consideration. With regard to the breakdown which occurred recently to a 500-KW. engine at the generating station, the Committee states that it was not unlooked for, in view of the fact that the whole plant has been working for the past two months excessively overloaded in consequence of the unprecedented increase in the demand.

ISLINGTON.—The existing low-tension mains in Tufnell Park Road are to be extended, and provision is to be made at the same time for lighting that thoroughfare by means of flame arc lamps at an estimated total cost of £1,326—£968 for cable, and £357 for 13 arc lamps and columns.

Maidstone.—The Electricity Works Committee of the T.C. has recommended the installation of a new reciprocating engine at a cost of £5,260, and the extension of the engine house, &c., at a cost of £500.

Perthshire.—Messrs. Nicoll & Co., Dundee, have completed an installation of electric light for Stanley Parish Church, Perthshire.

Portrush.—The Coleraine Rural Council has declined to give consent to the inclusion in an order which the Portrush Urban Council is seeking of the right, in the event of its boundary being extended, of the latter to supply electric light to certain areas on the outskirts of the township, which are now situated in the Coleraine rural district.

Portuguese East Africa.—The Portuguese Government has signed a contract with an English capitalist group, for the supply of electric current for lighting and industrial uses in Lourenço Marques and neighbouring districts. The trust is bound to provide from 10 to 12 million units per year, at agreed prices. The charges are considered likely to stimulate the growth of local industries hitherto held back owing to the cost of imported coal.—*La Revue Electrique.*

Rawtenstall.—The Corporation has had under consideration a statement showing the present cost of street lighting, and the estimated cost of same when the main roads are lighted by electricity, on the basis of the charges submitted by a special sub-Committee of the Tramways and Electricity Committee. It was decided that the borough electrical and tramways manager proceed with the electric lighting of Bacup Road, and that the Tramways and Electricity Committee be requested to state the terms on which it would be prepared to light and maintain the electric street lamps, provided the system of lighting is amended by not lighting the full number of lamps before 5.30 p.m.

Romford.—The County of London Electric Supply Co. has informed the R.D.C. that it intends acquiring compulsorily land at Dagenham on which to erect a generating station.

Smethwick.—The T.C. has decided to oppose the proposed transfer of the Smethwick E.L. Order from the Birmingham and Midland Tramway Co., to the Shropshire, Worcestershire, and Staffordshire Electric Power Co.

South Africa.—The Cape Town Municipal Council has considered a report from its electrical engineer, stating that general extensions of the electric lighting service in Cape Town

and its suburbs had become necessary, and submitting a list of wires and cables sufficient for six months, which he considers should be kept in stock. The list includes 33 miles of aerial braided wire, 15 miles of vulcanised rubber wire, one mile of concentric high-tension cable and 1,100 yards of three-core high-tension cable. The engineer states that it will also become necessary to increase the size of the sub-station for Green Point and Sea Point, and provide an additional feeder panel and two more transformer pillars. In addition, some 2½ miles of various sized armoured cables are required for underground services in Cape Town. It is proposed to invite tenders.—*Board of Trade Journal.*

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, on Monday, decided to apply to the L.G.B. for a loan of £20,000 for additional generating plant, owing to the plant at the power station being taxed to its limit.

Todmorden.—The T.C. has decided to advertise for an electrical engineer at £150 per annum.

Truro.—The T.C. has formally approved of the electric lighting scheme of Dr. Purves, of Exeter. The capital expenditure is estimated at £8,000.

U.S.A.—A recent *Times* article quotes the Census Bureau statistics for 1907, showing that there were then 4,714 central stations in the States, supplying during that year nearly 6,000 million units. Estimates as to the progress made in recent years place the number of stations in 1911 at 6,000, and the output at 10,000 million units. The *Financier* in a recent article states that the Southern Power Co. serves an area containing 420 cotton mills, with an equipment of 6 million spindles and 125,000 looms. Of these, current is supplied to 160 mills, with 2,373,000 spindles and 71,000 looms.

Watford.—The U.D.C. has decided to apply for a prov. order to enable current to be supplied to the parishes of Abbots Langley, Sarratt, and portions of Watford Rural.

TRAMWAY and RAILWAY NOTES.

Argentina.—Mr. R. H. Rarthland has applied to the Buenos Ayres Municipality for a concession for a service of electric trolley omnibuses between Flores, Belgrano, Plaza Constitucion and the Port.—*Review of the River Plate.*

Belfast.—On Monday afternoon, cars were run over the new extensions on the Stranmillis Road, Donegall Road, Ligoneil and Oldpark Road, and everything passed off satisfactorily. The remaining extensions will be tested this week, and it is expected that all the routes will be open to traffic in about a fortnight.

Burnley.—The manager of the Corporation electrical tramways has reported upon the working of a goods wagon on the Harle-Syke section for three months, and the Committee has, as a consequence of the nature of that report, decided to continue the experiment, and extend it to the main line from Padiham through Burnley to Nelson. The town clerk has been instructed to make application for the B. of T. consent.

The Tramways Sub-Committee has considered the means of communication to the Stoneyholme and Burnley Wood districts. There has been a suggestion that branch lines should be run.

Bury.—After considering the report of a sub-committee on the question of car accommodation, and particularly the week-end requirements, the Tramways Committee has decided to purchase four small cars.

Canada.—Already running over 50 miles of track, the Ottawa Electric Railway Co. is planning an outlay of $30,000 for an extension early next spring, to Ottawa South, an additional area taken into the city. Twenty new cars, of the pay-as-you-enter type, embodying all the latest ideas in steel construction, are being built at the Ottawa Car Works, one-half of which will be delivered on May 15th next. Owing to the interference of frazil or needle ice with the water generating system of the company's power plant, a steam auxiliary turbine has been ordered and will be installed near the present site, at the Chaudiere, at an estimated cost of $200,000.

Cardiff.—Mr. Arthur Ellis, the Corporation tramway manager, has reported to the T.C. as to the provision of additional travelling facilities outside the city boundaries. He suggests that powers should be obtained for the running of petrol-electric 'buses or that railless electric traction should be adopted, which could ultimately be replaced by ordinary tramways when the traffic developed.

Chesterfield.—The Parliamentary agents to the Corporation have deposited for introduction into Parliament next session a Bill to authorise the Corporation "to provide and run vehicles by means of railless traction and for other purposes" at an estimated cost of £58,180.

Conisborough.—The Mexborough and Swinton Trackless Tramways Co. has deposited with the P.C. plans of the proposed tramway system to Rotherham. The Council has deferred consideration of the matter.

Continental Notes.—BELGIUM.—A new electric tramway network is projected in the suburbs of Brussels, which will be joined to the Brussels city network, and the existing steam suburban line from Overysche to Groenendael will be converted to electric traction. The new network will have an extent of about 20 km., and is estimated to cost 2,500,000 fr., which will be jointly subscribed by the State, the Province, and the Communes interested. The Brussels Tramway Co. will permit the passage of the suburban cars as far as the boulevards of Brussels.

Electric tramway extensions are also projected on the outskirts of the city of Mons. As a preliminary, the Société Nationale des Chemins de fer Vicinaux have been requested to extend their Mons to Framerie line as far as the centre of the city, *i.e.*, to the Grand Place. In the second place the several existing steam lines are to be electrified successively. It is proposed, in addition, to construct four new lines. The total disbursement contemplated is about 1,500,000 fr., which will be shared by the State, the Province and the Communes concerned.

RUSSIA.—A company has lately been formed at Anaya, with a capital of 600,000 roubles and the title, Die Gesellschaft für Electrische Trambahnen in Anaya und Umgegend, to construct an electric tramway in the town and district of Anaya.

Dewsbury.—The General Purposes Committee of the Corporation has had under consideration a proposal to extend the tramways to Dewsbury Moor and Shawcross, at an estimated cost of something like £50,000. The Committee came to the conclusion that the Corporation's powers are inadequate to meet in a successful and satisfactory manner, the requirements of Shawcross and Westborough, and the Committee is to consider the advisability of a physical junction being formed between the two tramways. Negotiations are also to be opened with the Batley Corporation for an extension of tramways from the borough boundary in Staincliffe Road to the Butcher's Arms.

A trial trip was recently made by the members and officials of the Corporation in a 40-H.P. Daimler omnibus. The demonstration was made at the request of the Daimler Co., and from the routes traversed, it appears possible that alternatives may be considered to the two tramways schemes, although the matter has not yet been discussed by the Electricity and Tramways Committee.

Glasgow.—As previously indicated in the REVIEW, the T.C.'s Special Committee has had under consideration further extensions of the tramways system; with the recent inclusion of several suburban burghs and rural territory into the municipal area, the understanding was that the present routes would be lengthened and others added, and the Committee now propose an extension which, if approved by Parliament, will mean the laying down of anything up to 20 miles of double track. Among the proposed extensions are Burnside to Cathkin Braes, about 2 miles; Reddrie to Millerston, 1½ miles; Annisland *via* Scotstoun Hill to Dumbarton Road, about 2 miles; Baillieston to Coatbridge, 3 miles; and Clarkston to Busby, 3 miles. Application—should the T.C. approve—will be made to Parliament next November for construction powers, which, if granted, will permit the lines being completed within five years.

The Tramways Department still keeps piling up new records in connection with passengers carried and mileage run, since the doubling of the half-penny stage, though the total receipts are yet somewhat below those for the corresponding period of the last financial year. Since the beginning of the financial year on June 1st, 168,252,111 passengers have been carried, against 144,877,730, while the receipts have been £549,272, against £556,725. For the past week the takings were £20,016, and while the total number of passengers were not available, it was estimated that about 6½ millions were carried.

Halifax.—The Tramways Committee has decided to introduce a motor-omnibus service for Siddal, a suburb of the borough which is not reached by the tramways.

Holmebridge.—The Council has asked the Huddersfield Corporation to extend its tramways, and offered the same terms and conditions as the Corporation had approved with reference to the extension to Marsden.

Huddersfield.—It has been decided, subject to the Elland D.C. carrying out the necessary widenings on the route from the Elland Town Hall to West Vale, to continue the Elland tramway extension to West Vale; and that the Marsden extension be carried out at the original cost, viz., £14,500, the line to be double. The question of extending the tramways to Lepton and Whitley Upper has been before the Tramways Committee, and the matter has been referred to the Extension Sub Committee for consideration and report.

India.—The Karachi Port Trustees have resolved to ask Mr. C. H. Merz, who has been engaged by the Bombay Port trustees to advise as to the electrification of the port railways, whether he is willing to visit Karachi and report on the electrification of the port railways there. The manager of the North-Western Railway is also to be asked if the railways are prepared to share the cost of a report by Mr. Merz.

London.—On Monday morning a defective motor led to the holding up of the Piccadilly tube line for about half-an-hour, while later a somewhat similar mishap held up the Wimbledon service of the District Railway for an hour, in both cases causing great inconvenience to the numerous travellers at that hour.

Margate.—A modern system of electric signalling it to be installed at the Margate West Station by the South-Eastern and Chatham Railway Co.

Railway Power Proposals.—According to a financial contemporary, it is proposed to form a syndicate of railway directors to draw up a Bill to empower associated railway companies to produce electrical power on a large scale for their own use and that of the towns and villages along their routes.

Rochdale.—The traffic receipts on the tramways since the commencement of the financial year are £58,580, against £53,845 last year, an increase of £4,600. There were 9,350,000 passengers carried, an increase of half-a-million; the mileage was 1,196,000, an increase of 113,700. Ten new cars have been delivered, making 69 in stock. All the cars are being fitted with side guards as an additional precaution against serious accident.

Southampton.—Boxing day will be remembered at Southampton for a very high tide in the Solent, which invaded the Corporation electricity works on the western shore, and led to the electric tramway service being suspended for three hours.

Stirling.—It is stated that for financial reasons the Corporation is not prepared to go into an electric tramway scheme for the town and district. The opportunity seems a good one for a private company, as the need for a more up-to-date system should ensure no obstacles being put in the way of such an enterprise.

Swansea.—Negotiations are to be entered into with the Swansea Improvements and Tramways Co., with a view to arrangements being made whereby the extension of the tramways system authorised under the Swansea Corporation Act, 1912, which deals practically with the connecting-up of all the existing tramways, shall be carried out jointly by the company and the Corporation. The engineer is of opinion that by adopting this course many difficulties will be overcome.

Todmorden.—There were angry recriminations at the T.C. last week, over a proposal to purchase more motor-'buses. Alderman John Dawson declared it had cost £7,000 to keep 'buses running, which originally only cost £4,000. Mr. Rigby Dawson replied that Todmorden and Eastbourne had lost heavily by being the pioneers of municipal motor-'buses, but the makers had profited by their experience. The Council had better buy more 'buses than spend money on powers to run railless cars, which would cost a 2s. rate. The proposal to purchase was adopted.

TELEGRAPH and TELEPHONE NOTES.

Japan.—Owing to the inclemency of the weather and other difficulties, it is announced by the Japanese Department of Communications that the work of repairing the submarine telegraph cable between Japan and the United States has been suspended until August, 1913.

London-Paris Telephone.—There was no communication with Paris by telephone on Boxing Day owing to the gale; telegraphic communication with Jersey was also interrupted.

Marconi Wireless Patents in France.—We are informed that judgment has just been delivered in the High Courts of Justice of France in the action for infringement brought by Marconi's Wireless Telegraph Co. against La Société Française Radio-Electrique, La Compagnie Générale Radio-Télégraphique, and La Société des Transports Maritimes à Vapeur. The case was heard by three judges, and the judgment was unanimous. In the result the Court declares the validity of all the claims of the Marconi patent of 1900. All the defendants are declared to be infringers, and an investigation of their accounts has been ordered, to arrive at the amount to be paid as damages to the Marconi Co. The Court further orders the confiscation of all infringing apparatus supplied by the defendant companies, and a perpetual injunction, the defendants to pay the costs. This judgment is of the highest importance, and will have far-reaching effects, for the defendant companies have supplied all the wireless installations to all the departments of the French Government, including the Post Office, the Colonies, the Navy, and the Army, which embraces the station of the Eiffel Tower.

Reduced Telegraph Charges.—On January 1st, the following reductions in the charges for telegrams came into operation:—

The rate for deferred telegrams to Canada, Newfoundland and the United States is reduced by 1½d. a word for messages sent *viâ* the Anglo-American, Direct United States and Western Union Companies' cables. In the case of day-cable letters (which will in future be known as "night-cable letters") the rates for places in the east of Canada and the United States are reduced from 6s. for 21 words to 3s. for 13 words, and instead of being delivered on the second day after dispatch, they will reach the addressees on the day after they are sent. In the case of "week-end cable letters," for which the charge was 6s. for 31 words, the new rate is 4s. 6d. for 25 words, and they will be delivered on Monday instead of on Tuesday as at present. The rates for both classes of telegrams to other places in Canada and the United States vary according to distance.

Services of week-end cable letters are introduced with Australia, New Zealand, the South African Union, Rhodesia, and British Central Africa (Nyasaland). These messages, which must be presented for dispatch not later than Saturday evening, will be delivered on the following Tuesday, except in the case of distant places, where delivery may be somewhat later. The charge for week-end cable letters to Australia and New Zealand is 18s. for 24 words and 9d. a word beyond 24, and for week-end cable letters for places in South and Central Africa, 15s. for 30 words and 2s. 6d. for each group of five words beyond 30. These rates include the charge for delivery by post from the offices of the cable companies in Australia, New Zealand and South Africa.

Spain.—A movement is on foot at Bilbao, the great ore-exporting centre of Spain, to secure the establishment of a direct telephone line between that town and Paris.

The Damaged P. & O. Liner.—The *Narrung*, on her voyage through the Bay of Biscay, was badly damaged by the extraordinarily violent seas on Boxing Day, and sent out the wireless call for help. Mr. H. A. Reynolds, the wireless operator, was at work in the Marconi room for 40 or 50 hours on end. He stated that all through the gale the apparatus worked steadily, and there was little interference with messages. The "S.O.S." signal was responded to freely, and communication was established with a considerable number of vessels. None of them came nearer than about 60 miles, for the vessel was got under control and cancelled the call, returning to port under her own steam.

The Marconi Agreement.—On Monday Mr. F. Hall asked the Postmaster-General whether he would say what was the extent of the punishment inflicted on Mr. J. E. Taylor, staff engineer at the Post Office, owing to his purchase of Marconi shares; and were any other civil servants similarly punished for dealing in these shares?—Capt. Norton replied that Mr. Taylor had been reduced from the rank of staff engineer to that of assistant superintending engineer, the respective scales being £520 by £20 to £700, and £420 by £20 to £500. His actual salary was reduced from £540 to £500. No other officer of the department, so far as the Postmaster-General was aware, had dealt in the shares.

Trans-Atlantic Wireless.—For the first time the time signals emitted from the Eiffel Tower station were received in the early morning on Tuesday by the United States Government station at Washington, at a distance of 4,000 miles.

CONTRACTS OPEN and CLOSED.

OPEN

Atherton.—January 29th. One E.H.T. switchboard and one H.T. switchboard for the U.D.C. See "Official Notices" December 27th.

Australia.—VICTORIA.—January 10th. 14,500 metal-filament lamps, for the Melbourne City Council. See "Official Notices" December 27th.

January 28th.—Paper-insulated lead-covered cable for the P.M.G.'s department. See "Official Notices" December 20th.

February 21st.—Four 1,500-KW. rotary converters, for the Melbourne City Council. See "Official Notices" December 6th.

February 4th. Thirty-six Morse keys, for the P.M.G.'s Department. See "Official Notices" to-day.

January 24th.—Portable ammeters, voltmeters, transformers, &c. for the Melbourne City Council. See "Official Notices" to-day.

WESTERN AUSTRALIA.—February 19th. Armoured telegraph cable, for the P.M.G.'s department. See "Official Notices" to-day.

QUEENSLAND.—January 29th. Detectors (Schedule 242), for the P.M.G.'s Department. See "Official Notices" December 20th.

Belgium.—February 28th. The municipal authorities of Lierre are inviting tenders for the concession for the establishment of a central station for the supply of electrical energy for lighting and power purposes in the town. Full particulars of the concession can be obtained for five francs from Le Secrétariat de la Ville, Lierre.

Birmingham.—January 27th. Stores for a year for the Corporation Tramways Department. Mr. A. Baker, manager, Congreve Street.

Bispham-with-Norbreck.—January 18th. One oil or gas engine direct coupled to a 100-KW. dynamo, for the U.D.C. See "Official Notices" to-day.

Chile.—September 10th. An advertisement appeared in the *Times* on Wednesday stating that tenders are invited for the establishment of an electric central station and the distribution of electrical energy at the port of Valparaiso. The basis and specifications of the works can be obtained at the offices of the Chilean Legation, 48, Grosvenor Square, W.

Eastbourne.—January 14th. One 1,000-KW. horizontal steam turbine and alternator, without condensing plant, for the Corporation. See "Official Notices" December 20th.

France.—COMPIEGNE.—January 20th. Tenders are invited for the supply of the following plant:—70-H.P. effective hydraulic turbine, sets of electric motors, high and low-pressure centrifugal pumps, three 75-H.P. oil engines and 480-volt continuous-current dynamos, and the mechanical and electric transmissions needed for the working of the whole plant. Particulars of the Maire of Compiègne.

(*Continued on page* 23.)

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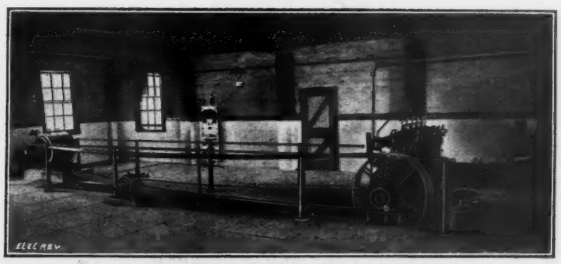
BRIDGING AUSTRALIA BY WIRELESS.

BY DR. ALFRED GRADENWITZ.

SHORTLY after the completion of the large Telefunken station at Pennant Hills, near Sydney, another powerful wireless station ordered by the Commonwealth of Australia was installed at Fremantle, and has now opened communication with Sydney across Australia, over a distance of about 2,500 miles.



GENERATING PLANT.

The new station is situated on a hill between Fremantle and Perth, on the southern bank of the Swan River. The hill, 136 ft. in height, is one of the highest in the neighbourhood, and is covered with woods, like the surrounding country. The station covers an area of 600 square metres, and is situated 4½ miles from the sea.

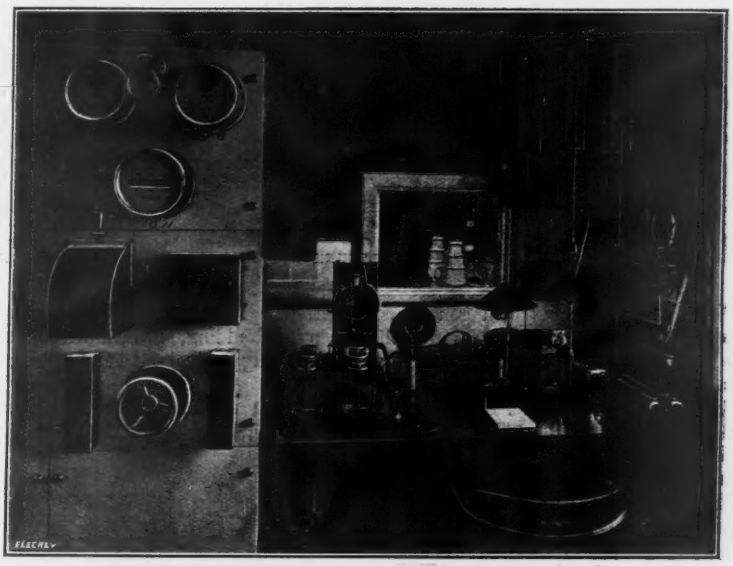
While mainly intended for purposes of defence, the new station is controlled in time of peace by the Postal Department, and is used almost exclusively for commercial telegraphic service with merchant ships and for the meteorological intelligence service. Since Fremantle is an important harbour, being the first point of connection for traffic *viâ* Colombo and Cape Town, the station is likely to render valuable services to navigation.

The centre of the area covered by the station is the highest point, and the tower there installed serves to carry the antennæ. This iron tower, 120 metres in height, is designed on the well-known Telefunken system, standing on a ball bearing, insulated from the ground by means of glass insulators, and is kept in equilibrium by three pairs of cables moored to concrete blocks, 150 tons in weight. Glass plates are used as insulators, and the antenna system, insulated from the tower, is arranged in umbrella fashion and comprises phosphor-bronze wires 3 mm. in diameter, joined up in three sets.

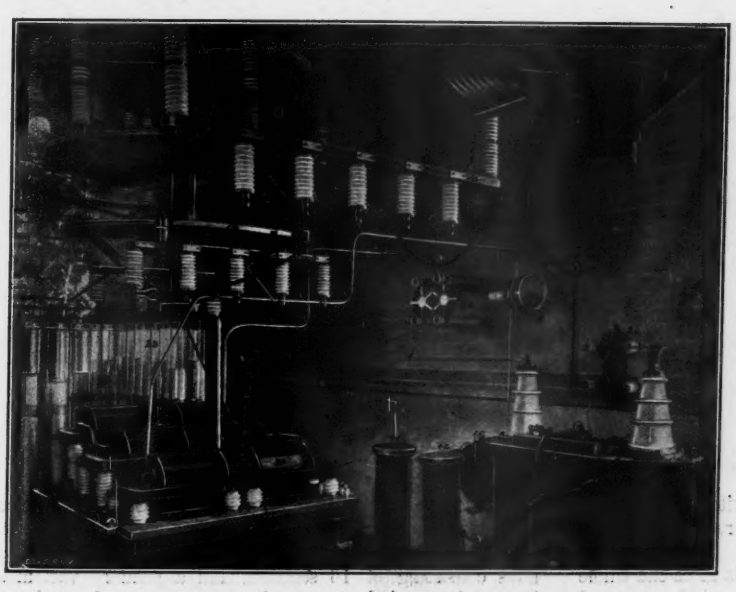
The leads enter the tower at 10 m. apart, parallel to one another. Each of the three sets is arranged between two pairs of tower cables, thus allowing the wires to be readily kept clear of these cables with a minimum elastic stress in the wires.

Since the sandy soil is extremely dry in summer (there is absolutely no rain during the six or seven summer months), while the underground water is at a depth of 42 m., much difficulty was experienced in establishing a satisfactory earth connection. An insulated counterpoise was therefore used, consisting of about 100 wires, 300 m. in length (phosphor-bronze of 2 mm. diameter), which radiate from the tower at 9 m. height, being insulated by means of four insulators arranged in series.

The wires are supported by three bronze wire circles suspended from telegraph poles, at 100, 200 and 300 m. respectively from the tower. The first circle comprises 12, and each of the others 24 telegraph poles; the first is 7·2 m., the second 5·4 m. and the third 3·6 m. in height, so that the counterpoise gradually approaches the ground, which assists in endowing the vibratory circuit formed by the antenna and counterpoise with a more open shape, thus ensuring a more satisfactory radiation and a more outward reflection of the wave from the counterpoise.



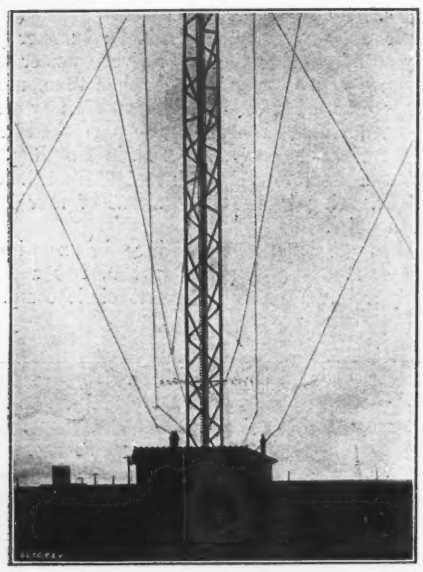
RECEIVING APPARATUS.



HIGH-PRESSURE ROOM: SENDING APPARATUS.

In 16 wires of the counterpoise, the first 100 m. have been left out, and the free space thus obtained contains the buildings and the wires connecting the antenna with the apparatus house. In addition to the large umbrella antenna (λ = 1,400 m.; c = 4,450 cm.), which serves for the sending and receiving of waves upwards of 1,600 m. in length, two T-antennæ for waves of 600 to 900 m. and a T-antenna for waves of 900 to 1,600 m. have been provided. The T-antennæ are arranged opposite one another, thus eliminating any screening effect of the tower and allowing

the antenna situated in the most favourable direction with regard to the corresponding station to be used. One end of these antennæ is fixed to, but insulated from, the tower, the other being attached to a steel wire subdivided by insulators and stretched out from the tower. The points of suspension are situated at a height of 60 m., the horizontal part being 2 × 25 m. in length. The constants of the two-wire antennæ for waves of 600 to 900 m. are : $\lambda = 570$ m. ; $c = 1{,}000$ cm., and those of the four-wire antennæ for 900 to 1,600 m. : $\lambda = 750$ m. ; $c = 1{,}600$ cm.



Wireless Station, and Base of Telefunken Tower.

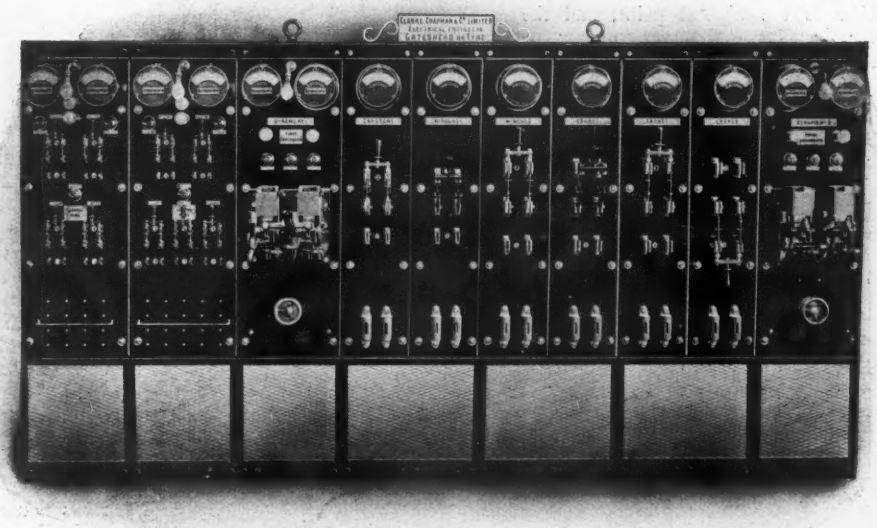
The station has its own generating plant, which is installed in a special room 25 m. from the reception building, so that the noise of the machinery and driving belts does not interfere with the receiving of telegrams.

The power plant includes an alternator of 60 K.V.A., at 500 volts and 500 cycles, driven by a four-cylinder Gardner oil engine of 75 H.P. The engine runs at a speed of 500 R.P.M., and the alternator at 1,500 R.P.M. Leather belts are used for power transmission, the distance between centres being 9·6 m. The engine can be fed with kerosene or gasoline, and compressed air is used for starting. Three water tanks are provided for cooling the cylinder. A continuous-current dynamo of 3 KW., also driven from the oil engine, serves to excite the alternator and to actuate the relays.

The wireless apparatus is installed in two rooms in a special building. One of these rooms contains the receiving table and switchboard, the Morse keys and switches actuating the high-pressure senders in the other room being installed on and beside the table.

The operator is able to control from his table the whole of the apparatus, while getting through a window a good view of the high-pressure apparatus and antenna ammeter. On the left hand is arranged the receiver, and on the right the key actuating the sender relay and the pressure regulator of the high-frequency machine. To the right on the front wall is situated the remote controlling gear of the variometer, and the sound tester and emergency receiving coils are suspended from the side wall. Other apparatus installed on the table are the call bell, the wave meter for testing the received signals and a contact button for actuating a signal bell in the power house. The receiver is equipped with an intermediary circuit and three parallel antenna condensers filled with oil.

Electrical Capstan, ss. "Fauvette."



Main Switchboard, ss. "Fauvette" (see page 21).

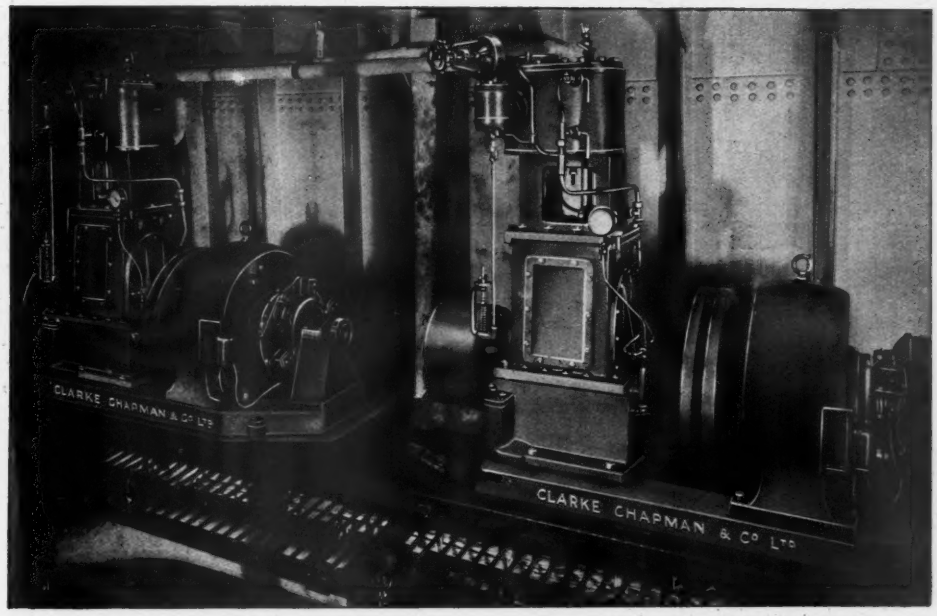
The sending apparatus comprises an A.E.G. high-pressure oil transformer for a ratio of 1 ; 120, a condenser battery of 36 Leyden jars connected up in series in six sets, six spark gaps consisting of 16 sections, and a primary variometer. Two primary inductance coils are used to determine the

resonating position between the alternator and the high-pressure transformer, two secondary inductance coils protecting the transformer against high-frequency currents. Variable flat copper coupling coils are used to connect the closed vibratory circuit with the antenna circuit. A hot-wire ammeter in the antenna circuit, which can be observed from the operator's seat, indicates the current intensity in the antenna.

The capacity of the condenser battery is 11,000 cm.; in the case of long-wave operation two sets of jars are cut out, thus increasing the capacity to 16,500 cm. A fan for cooling the plates has been provided for each two sets of spark gaps.

As the high-pressure switch of the receiver and that of the high-pressure compartment are so arranged as to be handled simultaneously with the left and right hands respectively, only a second is required for switching over from "sending" to "receiving," and inversely. The switch at the same time actuates the spark-gap fans and the sender relay.

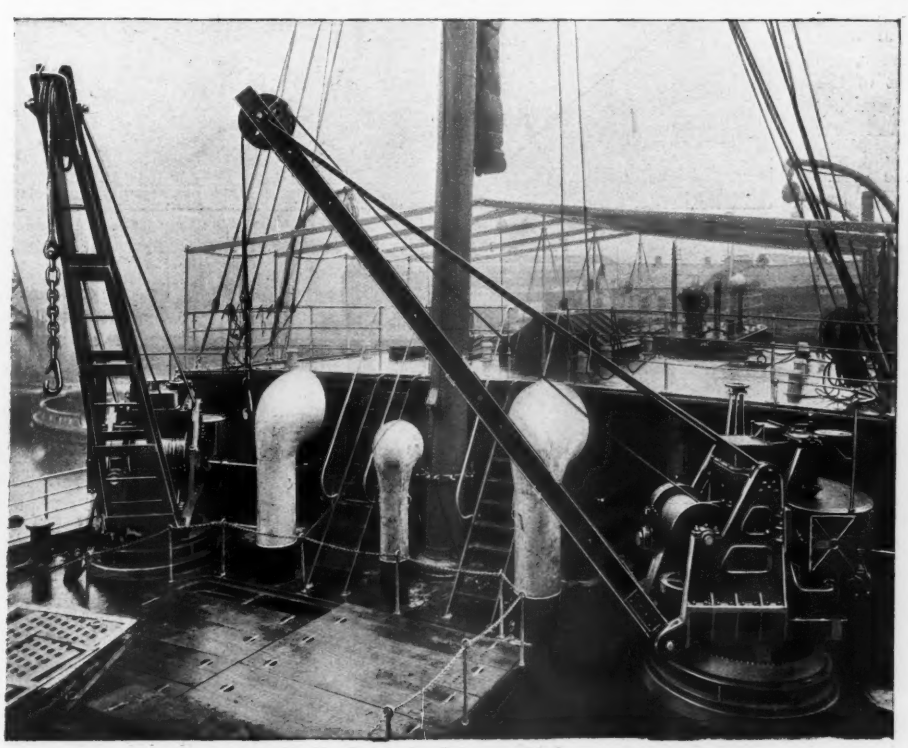
The new Fremantle station has been in operation since June last, and will shortly be taken over by the Government. In addition to communication with Sydney and with passing vessels, a regular Press service is carried on twice a day.



Generating Plants for Electric Lighting, Installed on the ss. "Fauvette."

ELECTRICAL DECK MACHINERY ON THE ss. "FAUVETTE."

An interesting addition has recently been made to the fleet of the General Steam Navigation Co. by the arrival in London of the steamer *Fauvette*, which has been built by Sir Raylton Dixon & Co., Ltd., to the order of the owners for their passenger and goods service between London and Bordeaux. The vessel is interesting, as it is probably the first vessel of the kind built in this country to the order of English owners in which the greater part of the auxiliary machinery is electrically driven.

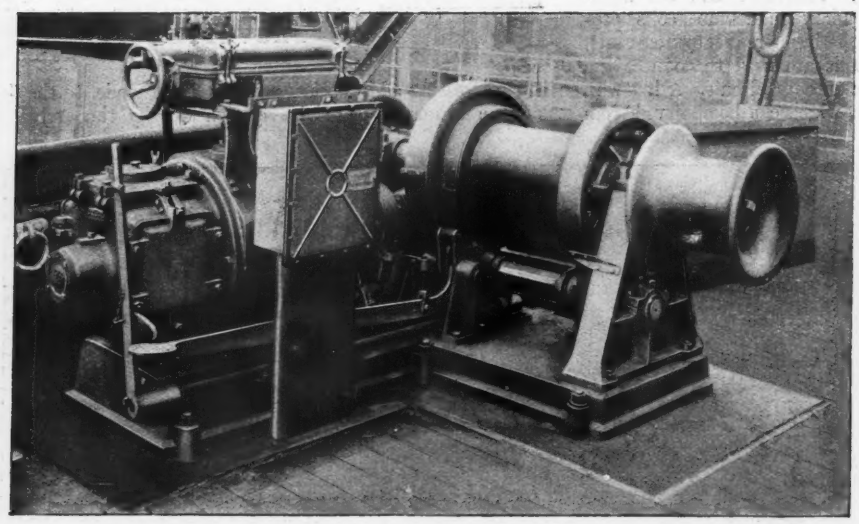


Electric Cranes on the After Deck, ss. "Fauvette."

This machinery has been supplied by Messrs. Clarke, Chapman & Co., Ltd., and consists of one windlass, two winches, six cranes and two warping capstans, with the necessary steam generating plants, switchboard and wiring.

The windlass is arranged to work 2-in. diameter cables, the winches lift 3 and 5 tons respectively, the cranes 1½ or 3 tons each, and the capstans exert a pull of 3 tons on the rope when warping the vessel.

The machinery has been specially designed for the rapid and quiet discharge of cargo, and, being electrically driven, will be of greater overall efficiency than steam equipment, as the power is concentrated in one large unit in which steam is used expansively, and the losses in the distribution of the



Three-Ton Winch, Showing Motor, Controller, &c.

power are smaller than in the case of steam-driven machinery.

All the power cables are led under the deck, which makes a very neat and desirable arrangement for a passenger vessel, as leaking steam pipes along decks or frozen pipes in cold weather are obviated. The various machines will also be ready for starting up immediately steam is available at the generating plants, no warming up being required, as in the case of steam-driven auxiliaries.

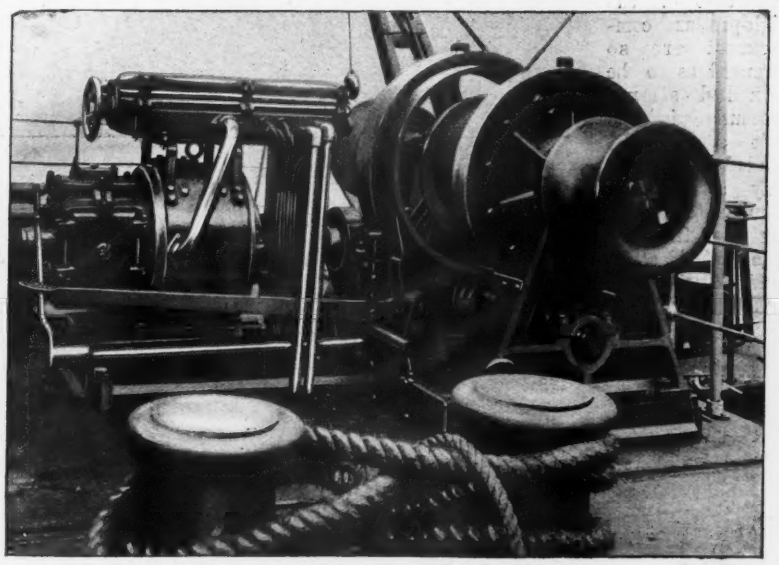
The windlass is of the maker's direct-grip type, in which the whole of the power of the motor is transmitted to the cable-holders, arrangements being made, however, to prevent damage in the event of the anchors being drawn too quickly into the hawse pipes. Hand gear is also fitted to the windlass.

The winches are of the worm and spur-geared pattern, with two lifting speeds, the second set of gearing lifting half the normal load at twice the normal speed; a clear lead of rope is obtained either forward or aft from the lifting barrel.

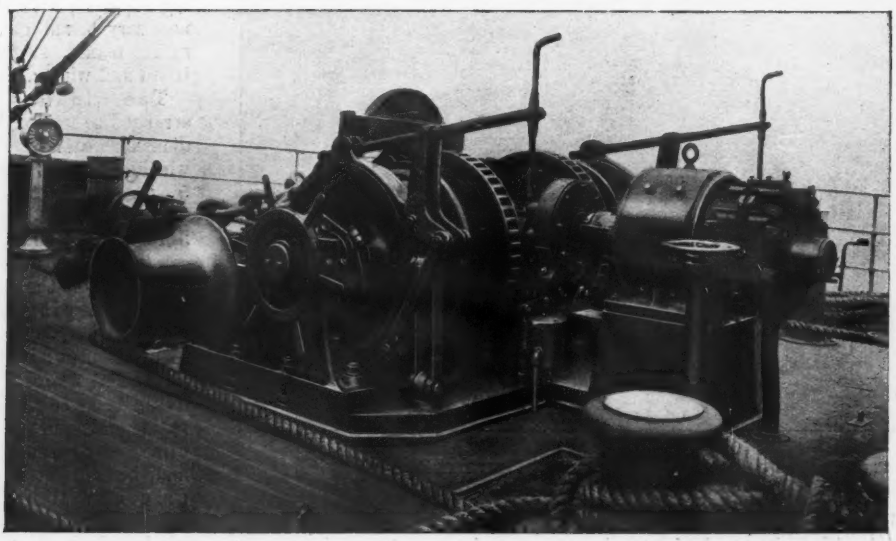
In the cranes the load is both lifted and slewed by power, separate motors being fitted for these purposes.

The control of the cranes is very simple, and the operating platform is raised so as to give the driver an uninterrupted view of the load.

The capstans are of the "above deck" type, having the motor and all gearing accommodated inside the capstan barrel which is of larger diameter than usual, and consequently increases the life of the ropes used; two speeds of hauling are obtained with the two diameters of the barrel.



Electrically-Driven Five-Ton Winch.



Motor-Driven Windlass.

Two generating sets are installed, consisting of enclosed compound engines fitted with forced lubrication to all bearings, each plant being capable of giving an output of 100 kw., which output will meet the normal requirements when loading or discharging. The second generating set, therefore, acts as stand-by, and can be brought into use when dealing with heavy cargoes at high speed.

The switchboard is of the change-over type, having separate panels for the various machine circuits and arranged to couple the latter to either of the generating sets.

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A complete system of circuit-breakers is also fitted to prevent damage in the event of excessive overloads.

The resistances for the various machines are of the electrical contractors' patent "Cracker" type, which are quite unaffected by vibration and are practically indestructible; these are made of an incorrodible metal in continuous strips, and mounted centrally so that each turn is free to expand or contract.

They are, therefore, eminently suitable for their duty, and the old trouble of replacing damaged units in a built-up resistance is entirely overcome.

At the trials all the machinery worked most satisfactorily, the machines lifting their test loads with ease and showing that they possess an ample margin of power. Simplicity of control was a noticeable feature, and the quiet working of the machines was favourably commented upon by the experts present, this being considered a most desirable feature as it would greatly decrease discomfort caused whilst loading or discharging. As cargo will be dealt with regularly at intervals of a few days, the installation will doubtless be a success from a financial as well as from an engineering standpoint, all the parts being carefully designed to withstand the heavy usage to which deck machinery is subjected. The vessel is efficiently lighted by electricity, this installation being supplied by the same contractors, but arranged quite separate from the power installation.

Energy in this case is provided by two generating sets either of which is capable of dealing with the normal load, the engines being of the enclosed type with forced lubrication to all bearings; separate lighting panels are arranged on the switchboard, these also being of the change-over type.

The wiring was carried out on the double-wire distribution-box system, the installation being divided into about 12 lighting circuits and six power circuits for the deck machinery.

The total number of lights is about 350, each cabin being fitted with two-way switches at the door and the bedside and plugs for a portable light and ventilating fan.

The saloon, smoke-room and writing room are also adequately lighted and electrically ventilated, the fittings being of silver-plated white metal to a design which harmonises with the general scheme of decoration in each case.

A wireless telegraph installation has been fitted, and an electrical ship's log with speed indicator on bridge. The signal lights are all controlled from the chart room where a patent signal light indicator is fitted.

The cables throughout the accommodation are lead-covered, the power cables and other wiring throughout the vessel being of the armoured type.

In conclusion, we are indebted to Messrs. Clarke, Chapman for this short description of an interesting installation, and we would add a word of praise for the owners, who are among the very few who have shown practical appreciation of the undoubted advantages of electrical deck machinery. Several of the new oil engined vessels have, and are, adopting this method of driving auxiliary machinery, and its economy and efficiency cannot be disputed now.

CONTRACTS OPEN.

(*Continued from page* 18.)

Cuba.—January 27th. "Dirección General de Comunicaciones," Havana. Establishment and working of a telephone system within a radius of 6½ miles of Real Campina, Término Municipal de Cienfuegos, Province of Santa Clara.—*Board of Trade Journal.*

Glasgow.—January 21st. Two 6,000-KW. turbo-alternators, with condensing plant and accessories, and water-tube boilers, for the Corporation. See "Official Notices" to-day.

Harwich.—January 13th. Four motor-driven centrifugal pumps, two motor-driven sewage rakes and screens, with switchgear, and about 400 yd. of 15-in. cast-iron rising main, for the Corporation. See "Official Notices" December 20th.

Italy.—The municipal authorities of Rome are about to invite tenders for the supply of the material required for the new electric tramway between the Piazza Independenza and the Porta Traionfale; the contract includes 600 tons of tramway rails, Mannesmann poles, the overhead conductors, trailing cars, &c.

London.—FULHAM.—January 9th. Steam dynamo, switchboard and connections for the Workhouse, Fulham Palace Road, W., for the Guardians. See "Official Notices" December 6th.

ISLINGTON.—January 29th. Electrical and engineer's stores for the year, for the B.C. See "Official Notices" to-day.

New Zealand.—January 30th. Two vertical Diesel engines of 150 B.H.P., each coupled to shunt wound dynamos of 100 KW., switchboard, crane, overhead mains and street lighting equipment, &c., for electric lighting at Thames. Board of Trade Commercial Intelligence Department, London.

January 6th. Switchboards, for the Auckland Harbour Board. See "Official Notices" November 15th.

Nottingham.—January 4th. The Corporation Tramways Department is inviting tenders for the supply of (*a*) 350 tons, steel tramway rails Bs B4, 150 tons, steel tramway rails Bs B4 (Sandberg), and (*b*) 5 tons, mild steel tie bars. Specifications and forms of tender (£1 1s. each returnable) from Mr. A. BROWN, engineer, Guildhall, Nottingham.

Plymouth.—January 23rd. Stores, for a year, for the Corporation Electricity and Street Lighting Departments. See "Official Notices" to-day.

Rottingdean.—January 7th. Installation of electrical fire alarms and private telephonic service, Warren Farm Schools, for Brighton B. of G. Mr. P. Coote, engineer, Central Chambers, North Street Quadrant, Brighton.

Sheffield.—January 23rd. General stores for the City Tramways Department. See "Official Notices" to-day.

Southey.—January 18th. The Fellwell New Fen Commissioners are inviting tenders for the supply, delivery and erection at Southey, Norfolk, of two centrifugal pumps having a capacity of 100 tons per minute, direct-coupled to two steam turbines. Specification and forms of tender (£3 3s., not returnable) from the consulting engineer, Mr. E. G. Crocker, Ely, Cambs.

Spain.—The municipal authorities of Torrecampo (province of Cordoba) have just invited tenders for the concession for the electric lighting of the town during a period of ten years.

Sweden.—January 8th. Fifty-ton electrically-driven trestle crane, for Alfkarleby power station. Time extended to January 8th.—*Board of Trade Journal.*

Uruguay.—March 29th. Five electric gantry cranes for Customs warehouses at Monte Video. B. of T. C.I. Department in London.

CLOSED.

Aldershot.—The U.D.C. has accepted the tender of Messrs. Wm. Cory & Sons, for 600 tons of coal, for the electricity works, at 17s. per ton.

Bedford.—The Borough Education Committee has accepted the tender of Messrs. W. S. Wilton & Co., of Bedford, for electrical work for the ensuing six months.

Belgium.—The Belgian military authorities are equipping all the forts and redoubts in the Antwerp district with electric lighting and power plants. In connection with the same, the authorities of the State Gun Works in Liége, opened the tenders for the supply of 46 dynamos, when it was found that the lowest offer was that of the Compagnie Internationale d'Electricité, of Liége.

BRUSSELS.—The results of the adjudication on the tenders returnable November 20th, for switchboards are as follows:—The Antwerp Telephone and Telegraph Works, Antwerp, 1,882 fr.; the Bell Telephone Manufacturing Co., Antwerp, 2,173·30 fr.; O. von Millmann, Brussels, 2,458·75 fr.; C. Richez, Brussels, 2,499 fr.

The results of the adjudication on the tenders returnable November 15th, for the installation of bells, telephones and electric clocks at the Ecole Normale d'Institutrias are as follows:—Société Force et Eclairage à St. Gilles, 3,166·60 fr.; C. Richez, Brussels, 3,327·65 fr.; Biske Livron et Kalinowski, Liége, 3,486·90 fr.; Telephonie Privée, Liége, 4,148·25 fr.; Soc. Belge Siemens and Halske, Brussels, 4,209·30 fr.

Bexhill-on-Sea.—The T.C. has accepted the tender of Messrs. Stephenson, Clarke & Co., for 150 tons of coal for the electricity works, at 19s. 7d. per ton.

Bridlington.—The T.C. has accepted the tender of Messrs. Stuart & Moore, of Ealing, W., for an installation of electric fire alarms on the hire-purchase system, £14 2s. 6d. to be paid each half-year for seven years.

Bristol.—The Council has accepted the tenders of the British Westinghouse Co., Ltd., and Messrs. Bruce Peebles & Co., Ltd., at £903 and £2,187, for extra-high-tension and low-tension switchgear and one three-phase to direct-current converter respectively.

Dundee.—The Corporation Electricity Committee last week had under consideration the question of the machinery contracts for the extensions at the Stanvergate station. A Sub-Committee was given powers to settle the matter.

Glasgow.—The T.C., at its last meeting, on a report by the electrical engineer, decided that the contract with the British Westinghouse Electric and Manufacturing Co., Ltd., for the supply of rotary converters, be extended so as to include two additional rotary converters, with the necessary high and low-tension switchgear.

The T.C. has accepted the following offers for the Tramways Department works :—

Special trackwork.—Titan Trackwork Co., Ltd.
Rawhide pinions.—Reid Gear Co.
Traction lamps.—Siemens Bros. Dynamo Works, Ltd.; General Electric Co., Ltd.
Double cotton-covered wire.—London Electric Wire Co., Ltd.
Copper and bronze strip.—P. & W. MacLellan, Ltd.

Greenock.—The Corporation has accepted the offer of the Westinghouse Co. for 5,000-KW. plant, subject to the latter providing a condenser of 7,650 sq. ft. area. The new machinery will involve an expenditure of over £12,000.

Halifax.—The Tramways and Electricity Committee has accepted the following tenders :—

Babcock & Wilcox, Ltd.—Two water-tube boilers and superheaters, £3,090, and chain grate stokers, £810.
British Thomson-Houston Co., Ltd.—Extra-high-tension feeder cell at electricity works, £82.
Drakes, Ltd.—Fixing of steel mains and cast-iron bends, £69.
Babcock & Wilcox, Ltd.—High-pressure steam piping and exhaust piping, £103.

Luton.—The T.C. has accepted the tender of Mr. Geo. Newbold, for about 2,500 tons of Whitwick slack coal for the electricity works, at 12s. per ton.

Preston.—The B. of G. has accepted the tender of Mr. E. Dewhurst, of Preston, for the renewal of the storage batteries for the electric lighting plant at Fulwood Workhouse, at £610.

Rhondda.—Messrs. Venner & Co. have received an order for equipping the Rhondda Tramways with Chamberlain and Hookham meters.

Rugby.—The U.D.C. has accepted the tender of W. T. Henley's Telegraph Works Co., Ltd., for 440 yards of 15 low-tension, three-core, paper-insulated and lead-covered cable.

Walthamstow.—The tender of Mr. G. P. Trentham has been accepted by the U.D.C., at £16,692, for carrying out alterations and additions to the permanent way.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday evening, January 3rd. Paper, "Some Notes on the Practical Operation of Electrical Machinery for Power Purposes," by Mr. C. E. Catterson.
Wednesday, January 8th. At 8 p.m. At the I.E.E. Lecture on "Heating of Buildings by Means of Hot Panels," by Capt. H. Riall Sankey.

Association of Engineers-in-Charge.—Saturday, January 4th. At St. Bride's Institute, E.C. Social. Dance.

Institution of Electrical Engineers (Newcastle Students' Section).—Monday, January 6th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on "Phasing Out of Alternating-Current Apparatus," by Mr. J. Hacking.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, January 7th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Automatic Circuit Breakers," by Mr. A. N. Haworth.

Institution of Electrical Engineers (Glasgow Students' Section).—Tuesday, January 7th. At 8 p.m. At the Royal Technical College, Glasgow. Debate.

Rugby Engineering Society.—Tuesday, January 7th. At 8 p.m. At Benn Buildings, Rugby. Paper on "Large Steam-Turbo Units," by Mr. J. P. Chittenden.

Institution of Electrical Engineers (Birmingham Section).—Wednesday, January 8th. Meeting at the University, Birmingham.

Institution of Electrical Engineers (London).—Thursday, January 9th. At 8 p.m. Paper on "The Design of Apparatus for Improving the Power Factor of A.C. Systems," by Prof. Miles Walker.

Concrete Institute.—Thursday, January 9th. At 7.30 p.m. At 296, Vauxhall Bridge Road, S.W. Paper on "Concrete in its Legal Aspect," by Mr. W. Valentine Ball.

Institution of Electrical Engineers (Dublin Section).—Friday, January 10th. At 8 p.m. At the Royal College of Science, Dublin. Paper, "Notes on Self-Propelled Cars for Light Railway Work," by Mr. J. P. Tierney.

Electro-Harmonic Society.—Friday, January 10th. At 8 p.m. At the Holborn Restaurant. Smoking Concert.

London Telephone Service.—With the new year, the Post Office opened new exchanges called the "Regent" and "Park" exchanges, and transferred some thousands of subscribers from one exchange to another. Twelve months hence, the "Charterhouse" exchange will relieve the "City" and "London Wall" exchanges, and the "Museum" exchange in Tottenham Court Road will be opened.

NOTES.

Index.—The Index to Volume 71 of the ELECTRICAL REVIEW, July to December, 1912, will be published with our issue for next week.

Inquiries.—The name of the maker of the Harman electric hoist is inquired for; a correspondent wishes to get into touch with the makers of the electric table-cloth.

Fatalities.—An inquiry was held on December 26th by Coroner J. T. Proud, at Billy Row, a mining village in the county of Durham, into the death of William Nicholson, 52, a miner, who lived at Billy Row and worked at Bowden Close colliery. From the evidence it appeared that Nicholson was going home on Christmas eve from work at the pit with a man named Hetherington. The night was very stormy, and as the men turned into Institute Terrace, they fell over a live wire which formed part of the electric lighting installation. Both men received severe shocks and fell to the ground. At the same moment the electric light in the house of another pitman went out, and he went out to ascertain the cause of its extinction. Hearing shouts, he went forward a short distance, and saw Nicholson and Hetherington rolling on the ground. Assistance was at once obtained, but when removed from contact with the wire Nicholson was dead, but Hetherington was able, after attention, to go home. Mr. S. Wraith, the chief electrician for Messrs. Pease & Partners, the owners of the colliery, said the voltage of the current was from 225 to 230 alternating. It was not customary to protect such wires. Nicholson's damp clothes and his tin bottle would act as conductors. The jury returned a verdict that deceased had been accidentally killed by an electric current through the wires having been blown down by the storm. They were of the opinion that better means should be found to protect the wires crossing a public thoroughfare.

According to the *Australian Mining Standard*, Mr. A. M Webb, an electrical engineer employed by the Adelaide Tramway Trust at the Port Adelaide power house, was killed last November through contact with a wire carrying 11,000 volts. When he was discovered he was still living, but all efforts to restore consciousness failed.

A young man named Ernest Lancaster (17) was killed on Saturday, 28th ult., at the Weardale Steel, Coal and Coke Co.'s by-product coke ovens at Tudhoe Ironworks. He was somehow caught by a live electric wire, and his death was instantaneous. He had only been at work a few months when the affair happened.

A Committee Dissolved.—Our readers may remember that several years ago there was formed a Committee for the Protection of Electrical Interests. We have just received from Mr. R. Borlase Matthews, the hon. sec., a copy of a circular which has been issued to the members, informing them of the dissolution of the Committee consequent upon the formation of an Industrial Committee by the Institution of Electrical Engineers, to which the work of the Electrical Committee has been transferred. The circular reads thus :—

"I beg to inform you that, in accordance with the directions of the Committee, a letter was addressed to the Institution of Electrical Engineers suggesting that they should take over the work of the Committee by the formation of an Industrial Section or Committee of the Institution.

"I have now the pleasure of advising you that the Council of the Institution, at its meeting on March 28th last, passed the following resolution :—

"1. That an Industrial Committee be appointed by the Council, to which there shall be referred, for consideration and report, all industrial matters coming before the Council, and whose business shall also be to report to the Council on any industrial matters which, in the opinion of the Committee, affect the electrical industry and in respect of which the Institution might usefully take action.

"2. That the Committee consist of :—

"(*a*) Eighteen Members drawn from the Members, Associate Members and Associates of the Institution, at least six of whom shall be members of the Council :

"(*b*) And, if so desired by the Council, other persons not exceeding six in number, connected with other organisations, and not necessarily members of the Institution.

"3. That the chairman of the Committee be elected by the Council.

"4. That the Parliamentary Committee be merged into the Industrial Committee, and that the latter take over the work of the existing Parliamentary Committee.

"5. That, subject to the Council's approval on each occasion, the Committee arrange for special meetings of various branches of the electrical industry in the Institution building, at which the chair shall be taken by a chairman appointed by the Council.

"6. That the Council inform other bodies of the appointment and existence of the Committee, and ask them to submit from time to time any matters which they consider should be taken up by the Institution.

"And an announcement has recently been made that the following Committee has been elected :—[These names have already been published in the ELECTRICAL REVIEW.—EDS.]

". . . . In view of the appointment of the above Committee, it is deemed desirable that our Committee for the Protection of Electrical Interests should be dissolved, and that the small balance of cash in hand be handed to the Institution of Electrical Engineers to be placed to the credit of the Industrial Committee, and unless I hear from you to the contrary, I shall take it for granted that you are in agreement with this course being pursued."

The Midlands Electrical Engineers' Ball.—The second annual ball given by the Midlands Electrical Engineers took place at the Grand Hotel, Birmingham, on Friday, the 20th ult., and was, if possible, a still greater success than that of the previous year, in spite of many absences owing to the unavoidable nearness of the event to the Christmas holidays. Many friends were able to be present from London and the North, and Mr. Chattock, who was chairman of the Dance Committee, is to be congratulated on having assembled such a representative gathering, and on providing such an enjoyable evening.

Entertainment.—On Saturday evening, December 21st, the Mechanics' Large Hall, Nottingham, presented a most animated appearance, the occasion being the Christmas entertainment provided by Mr. Jardine for the children of the employés at the various factories. This is the twenty-eighth year in succession that Mr. and Mrs. Jardine have entertained the children. The number present was over 1,500.

E.T.B.I. Whist Drive.—Mr. F. B. O. Hawes, the secretary, is organising on behalf of the Electrical Trades' Benevolent Institution a Whist Drive, which will be held at Slater's Restaurant, 50, Cannon Street, E.C., on the evening of Friday, January 17th, at 7 o'clock for 7.30. Prizes are being given by the directors of firms interested, and others. Tickets, price 2s. 6d. each, inclusive of music and refreshments, may be obtained from the following members of the Committee:—C. H. Champion, Union Electric Co.; B. E. Crowe, Sterling Telephone Co.; F. B. O. Hawes, Electrical Trades B.I. (18, Park Mansions, Vauxhall Park, South Lambeth Road, S.W.); A. J. Williams, General Electric Co. The object of the event is to make the Institution better known among those who ought to become members, and not to make any money out of the entertainment itself. Mr. Hawes will occupy a few minutes during the evening to explain the objects of the Institution, and the advantages of membership.

Electricity for Train Lighting.—Lieut.-Col. Sir H. A. Yorke's report to the B. of T. on the railway accident at Ditton Junction on September 17th, 1912, was issued on December 20th. Regarding the fire which broke out and destroyed several of the coaches, the Inspector says:—

The two horse boxes at the front of the train were lighted by oil lamps, the sixth and ninth carriages by electricity, and the remaining five vehicles by gas. There are two gas cylinders to a coach, each with a capacity (at 100 lb. pressure per sq. in.) of 56 cb. ft. of gas. In this case they were probably not more than half full. The cylinders of the three wrecked coaches, viz., the third, fourth, and fifth, were only dented, and were not broken or pierced in any way, but the pipes and connections leading from them were broken off, and the gas was free to escape. One of the witnesses (Porter Ryan) says that when the engine struck the bridge he saw a volume of flame burst from it, and this probably set fire to any gas that might be escaping from the carriages as they passed the engine. Apart from this, it is well known that a very small spark is sufficient to ignite gas when escaping into the air, and there must have been plenty of red-hot cinders from the engine, and sparks from the wheels, flying about the train during the process of destruction. The immediate appearance of fire, the rapidity with which it spread, the fierceness with which it burnt, and the manner in which it resisted for nearly two hours all the efforts to quench it, can, in my opinion, only be attributed to the presence of gas. The fire first showed itself in the heap of wreckage against the wall which supports the booking office. It soon enveloped the fourth and fifth coaches, which were burnt out. The leading end of the sixth coach, which was lighted by electricity, was also destroyed by fire, owing to the fact that it was entangled in the wreckage of the other two, by which it was set alight.

The arguments for and against the use of gas for lighting trains are fully given in Major Pringle's report dated 31st January, 1911, upon the collision which occurred at Hawes Junction, and it is not necessary for me to repeat them here. Major Pringle came to the conclusion that, although steps might be taken to lessen the risks attendant upon the use of gas, "electric lighting would still be the safer method," and "should be adopted wherever possible." It is to be regretted that up to the present time no unanimous action has been taken by the railway companies to meet the representations of the Board of Trade, which were based upon the above report. Some companies are in favour of electricity, while others champion the use of gas. The chief point on which opinions differ seems to be that of cost. I have been personally assured by responsible railway officers that gas is far the cheaper illuminant of the two, while other officers equally responsible have been confident that the balance is in favour of electricity. In view of these conflicting opinions, it may be assumed that the difference in cost does not amount to much, and depends chiefly upon what items are included in the term "cost." So far as safety is concerned, there can hardly exist in anyone's mind a doubt that electricity is the better, and I think the railway companies would be wise to recognise this fact and adopt electricity as the standard illuminant on all their main-line trains before they are compelled to do so by the pressure of public opinion.

In fairness to the London and North-Western Railway Co., I should say that gas has been used by it on its trains for 30 years, during which period, I am told, 2,937 millions of passengers have been carried, and this is the first occasion on which it has been suggested that gas has been concerned in the burning of one of its trains. A large number of its carriages are already lighted by electricity, and the number is increasing yearly. But the company has not as yet gone so far as to adopt electricity as the standard illuminant.

University of Hong-Kong.—We recently published a list of the machines required for the equipment of the engineering departments of the new University of Hong-Kong, of which Prof. C. A. M. Smith is the head, and urged our readers to take advantage of this unique opportunity of securing the finest of all advertisements in the eyes of the embryo engineers who are now joining the University. We have since heard from Prof. Smith that the first to respond to the invitation were the Chloride Electrical Storage Co., Ltd., who telegraphed to him promising to present a complete set of their well-known accumulators; the Hart Accumulator Co. have also presented a number of cells, and the Walsall Electrical Co., Ltd., have presented a quantity of electrical instruments. Messrs. Marshall, Sons & Co., Ltd., have cabled out offering a complete steam engine and condensing plant. Oil engines and all kinds of electrical apparatus are urgently needed by the University, as well as physical and scientific instruments.

Prof. Smith writes that the longer he is in Hong-Kong, the more convinced he is that the place is the "springboard" for British trade with China, and that our manufacturing firms will never get another chance such as this for creating an indelible impression upon the minds of our Oriental customers. Out of 55 new students, 37 are engineers. We may mention that, while the tonnage of shipping cleared at Liverpool in 1910 was 7½ millions, that of Hong-Kong was no less than 11 millions—a far greater total than that of any other port in the British Empire, except London. Practically, the island is the gateway of British trade with China and the East, and its further development as the centre of scientific and engineering training in those regions will immensely increase its importance and prestige. There are no tariff walls to hinder our access to the markets of the vast population which is now bestirring itself and is beginning to devise ways and means of utilising the riches with which the country is endowed by Nature; we are on an equality with our rivals in this respect, and superior to them in the quality of our products, but if their manufactures are permitted to pervade the laboratories of the University and to impress themselves upon the student engineers, we shall be greatly handicapped in the battle for trade. As both an individual and national duty, we again urge upon our readers the importance of making those laboratories a first-class showroom and permanent exhibition of British manufactures.

Appointments Vacant.—According to an advertisement in the *Times*, the post of superintendent of the Magnetic and Geo-Physical Observatory at Eskdalemuir (Dumfriesshire) is vacant (salary, £400 to £500), and applications have to be lodged by January 31st. Particulars from the Assistant Secretary of the Royal Society, Burlington House, W.C.

One senior switchboard attendant (32s. 6d.), and two junior switchboard attendants (26s.), for the Salford Corporation. Junior telegraph engineer, for the Uganda Protectorate Government (£250). See our advertisement pages in this issue.

Electricity in Spain.—A Comision Permanente Espanola de Electricidad has just been appointed in Spain, under Government auspices. D. José Echegaray has been invited to become the first president of the new body.

Billiards.—The final of the billiard handicap for the Challenge Cup, presented by Mr. J. H. Cowell, manager of Blackburn Corporation Tramways, for competition amongst the employés, was played on Friday evening. The contestants were Inspector G. H. Woods and Mr. D. McEvoy, who was last year's winner. The cup was eventually won by Inspector Woods, who was also presented with a gold medal by Mr. J. L. Redmayne, whilst Mr. McEvoy was given a leather pocket wallet as a consolation prize. Alderman Houlker Watson made the formal presentation.

Bradford Strike.—At Bradford City Police Court, last week, Albert L. Raistick, of Idle, was fined 20s. and 23s. costs, for having, as a Trade Union picket, thrown an egg at an electrician named Charlie Mounsey, who had remained at work during the electricians' strike in Bradford.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (SCOTTISH LOCAL SECTION).—There was an attendance of about 300 gentlemen at the annual dinner of the Scottish Local Section, which, as mentioned previously, was held on December 17th. Mr. Wm. M'Whirter, the chairman, presided. Engineer Commander Wood, who responded for the Navy after the "Imperial Forces" had been proposed by Mr. Robert Caird, LL.D., spoke of the connection between the electrician and the Navy. The electrician had shown that there was nothing too heavy or too light, nothing too large or too small for him to tackle. He weighed the anchor and mixed the dough for bread. He ventilated the ship and he lighted it. His were the means by which the captain in his cabin could tell the officer on the bridge what he thought of him, and also by which the admiral on the flagship could tell the captain what he thought of him. The electrician warmed the cabins and cooled the magazine. He hoisted the ammunition and the coal. He pumped the bilge water and flooded the seascape with light, and one day, no doubt, would take a hand in driving the ship. Lord Provost Stevenson responded to the toast of "Glasgow Corporation," and had much to say regarding the work of the electricity department of the T.C. in the effort to get rid of the black smoke in the atmosphere. He pointed out that it was the business of the electrical engineers to show the citizens how to carry on their industrial concerns without the smoke pall above them all the time. He understood that since the amalgamation of some of the neighbouring areas the electricity department has been inundated with orders from large manufacturing

concerns, and he could see the smoke pall visibly disappearing, because those orders for large power supplies from the department meant nothing if not a diminution of smoke. The more the electrical engineers convinced the users of power that that power could be supplied through electricity, the sooner would the smoke cloud be dispelled; the Corporation, therefore, looked to the electricians primarily for that evolution. He was delighted to hear from the chief electrical engineer, Mr. Lackie, that he was now developing 37,000 H.P. Mr. Lackie had shown them in the recent Smoke Abatement Exhibition that almost everything under the sun could be done by electricity. The toast of the "Institution of Electrical Engineers" was proposed by the Bishop of Glasgow and Galloway, and Mr. Duddell, the President, in response, said that while it was true that the membership had grown from 700 to about 7,000 after 40 years of existence, that, he took it, was an indication of the growth of the electrical industry, for to-day it was one of the most important industries in the country. As to the part played by electricity on board ship, his opinion was that the day was not far distant when it would play a far greater part. They had heard of the success of the Glasgow electricity department in abating the smoke nuisance, but they had also got to attack the domestic fire, which, after all, was the chief offender in their great cities. At the summer meeting of the Institution in Glasgow, Dr. Silvanus Thompson read a most interesting paper on "Magnetism and the Permanent Magnet." Arising very much out of that paper the Institution had decided to form a Research Committee, which was going to co-ordinate the electrical researches which were going on all over the country, and to start research on electrical subjects. In his paper Dr. Thompson showed very clearly the necessity there is of co-ordinating research on the magnetic properties of steel, and they hoped that that might form part of the work to be dealt with by the Institution. As to internal affairs, they had, he believed, a successful Students' Section in Glasgow; it had come to his knowledge that some of the students did not like being made graduates, and he wished it to be clearly understood that the Council in transferring many young men from the class of student to that of graduate did not wish them to remain permanently in that class. Many young men who had not had sufficient number of years in practice were advised to be transferred into the graduate class, but it was hoped that in due course they would apply to be transferred to associate membership and the other higher classes of the Institution. He was the first president who had climbed the Institution ladder, starting as a student and going through all the various grades, while another curious fact was that he happened to be the same age as the Institution. Acknowledging the Scottish Local Section, proposed by Mr. R. K. Morcom, Mr. McWhirter pointed to the fact that the Institution was growing increasingly useful to the whole membership. Their Local Section at its start 12 years ago had 158 members; to-day it had 400, drawn from all parts of Scotland. The chairman went on to review the growth of electrical industry and the tramways undertaking in Glasgow in the last 20 years, and concluded by urging those concerned to take steps for the provision of improved educational facilities on sensible practical lines, not too highly pitched for their apprentices who were too often hampered and discouraged by an overdose of mathematics at their entrance into a technical college.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (EAST OF SCOTLAND BRANCH).—The monthly meeting of the branch was held in Kircaldy on Friday, 20th ult., and took the form of an "open night," to which all interested in the handling of electrical plant were invited. A paper was read by Mr. A. B. Muirhead (Glasgow), on "The Maintenance of Colliery Electrical Plant," addressed particularly to the "authorised persons" under the new Electricity Rules.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (WEST OF SCOTLAND BRANCH).—At the last monthly meeting of the Branch Mr. Sidney A. Simon, B.A., Glasgow, read a paper on "The Speed Control of Three-phase Motors." While not holding a brief for the universal adoption of three-phase current, knowing that there were many applications of electric power for which direct current was undeniably superior, the author described the most important of the methods of three-phase speed control which had been successfully developed, and afterwards the methods of imperfect speed control. He did not favour the latter, as in each case the variation of speed was effected in steps, and intermediate speeds were only possible by wasting energy. The discussion was adjourned till the next meeting.

THE SOCIETY OF ENGINEERS (INCORPORATED).—The Council of the Society may award in 1913 a premium (the "Status Prize") to the value of £10 10s., for an approved essay on "A scheme for the registration of Engineers, including particulars concerning the registration of Engineers in British Colonies and foreign countries." The competition is open to all, but, before entering, application for detailed particulars should be made to the Secretary, 17, Victoria Street, Westminster. The last date for receiving essays is May 31st, 1913.

ROYAL SOCIETY OF ARTS.—On Monday evening, January 20th, Prof. Vivian B. Lewes will deliver the first of his Cantor Lectures on "Liquid Fuel." On January 27th the second will be delivered. "Co-partnership" is the subject of a lecture to be given on January 29th, by Mr. Aneurin Williams.

Uniflow Engines.—A correspondent asks, Why so much fuss about the uniflow engine, as though it were a new idea but recently put into execution? The uniflow engine has acquired a new name, but there its novelty stops. There have been two well-known examples of the principle at work for many years in very great numbers. The chief in point of number was the Willans engine, which carried out the uniflow principle by means, not of a ring of exhaust ports round the cylinder to be uncovered by the piston, but by a central valve with exhaust ports at the piston face.

It was a well-founded claim of the Willans engine that good drainage was secured, for all water which reached the piston was able quickly to escape by way of the central valve. The engine filled a certain want, viz., the demand for an engine to run as quickly as a dynamo, and so avoid belt driving. The ideas of Mr. Ferranti were not then accepted as they are universally accepted to-day; the ideas which gave the little engine its success were those which produced long engine rooms with the vanishing point perspective view of a long line of engines, each of a few horse-power, exhausting preferably to atmosphere.

Then Mr. Raworth brought out a uniflow engine, in which the exhaust took place through a ring of ports in the cylinder, which were uncovered by the piston. The same idea is carried out in the Körting gas engine.

It is somewhat doubtful if either of the steam engines named gave any better dryness results than the horizontal Corliss engine which collected its water at the exhaust valve to which much of it was shot across the cylinder directly from the inlet valve. But a vertical engine without superheat is bound to be wet on its upper end, and drainage at the piston face level or near the cylinder middle shows good results. But it is very doubtful if the uniflow principle is worth the sacrifice of the double-acting principle, for the water drainage ceases to possess any supreme importance when steam is superheated, for there should be none to drain.

It is questionable if a uniflow engine with exhaust only by way of the cylinder middle ports would satisfactorily clear itself of steam in the time these ports are open; that is to say, unless a very excellent vacuum exists, the steam remaining in the cylinder will compress to a considerable pressure on the return stroke. High compression has not usually been beneficial beyond the point at which it produces easy, quiet running of an engine, for, when all is said, power is absorbed in doing the work of compression and cannot all be recovered.

Novelties in steam engines have rarely lived long. The reciprocating engine seems to have reached a fixed type, and to have reached its best in the upright position as a thing with a backbone, just as the animal creation appears to have reached its height in an upstanding vertebrate with limbs. So the engine, which has gone through repeated cycles of horizontality, appears to have been always at its best when vertical, the locomotive, like all draught animals, being of horizontal type.

The turbine is the one uniflow engine in which the principle is at all fully carried out. No reciprocating engine has carried uniflow into practice better than the Willans or the Raworth, and there are objections to mid-cylinder ports. Indeed, all the advantages of mid-cylinder ports are probably to be got by a system of small drain holes only, to let out water and some of the steam, leaving the remainder of the steam to the usual exhaust valve. Indeed, did not the Raworth engine follow this plan?

The Cost of Electric Vehicle Operation. — An American contemporary, quoting investigations made by the Massachusetts Institute of Technology, states that for parcel delivery, with a nine-hour day, three trips, four parcels delivered per mile and with one minute consumed in each delivery, three-quarters of an hour being allowed for loading and the maximum load being half a ton, the horse-drawn vehicle does only two-thirds as much work a day as the electric or gasoline truck, at a cost per delivery of 5.9 cents, 5.4 cents and 6.5 cents, respectively. The cost per mile by horse is likewise between the two other costs. In the delivery of coal, which is a very different kind of delivery, at the heavy end of the scale, with loads of 5 tons, the horse wagon (three horses, one resting every third day) does only about half as much work per day as either of the motor-trucks. The cost per mile here runs in much the same way as with the light work, being 55 c. for horses, 47 c. for electric, and 58 c. for gasoline, while the costs per delivery are in the same order, $3.91, against $3 32 and $4.07. Some experiments have been made in special service requirements as affecting the cost of operation, and for the parcel delivery two minutes per call has been allowed instead of one. This increases the standing time, reduces the mileage per day, lessens the distance factor and raises the cost of delivery.

Gas Producers.—Commenting on our article on the slagging type of producer, Messrs. Appleby & Co. call our attention to the Kerpeley gas producer, in which the fuel is supported by a conical rotating grate which automatically discharges ash, and is claimed to be capable of gasifying low-grade fuel, coking or non-coking, and coal of all grades from lump to slime. The lower part of the producer is a water casing, to which clinker cannot adhere, the upper part having the usual refractory lining. The grate stands up in the middle of a water trough, which forms a water bottom to the producer. This water bottom, with the upstanding grate, rotates bodily round a vertical axis upon balls in a circular ball race. A fixed scraper is arranged which discharges the ash from the water bottom over the edge of this, the scraper being fixed at such an angle that the ash slides up its face and drops outside the rotating dish bottom. The cone is not quite concentric with the axis of rotation, but its vertex is a trifle eccentric. As the grate rotates this eccentricity has a moving effect on the fuel, and assists to work the spent fuel downwards and outwards until it drops off the lower edge of the cone into the water bottom. The grate is not circular, but polygonally elliptical, so as effectively to crush up clinker if this forms lumps. Rotation is not rapid—one turn in 2½ to 4 hours. Owing to the cleanliness of the fire and its openness, secured by the effects of rotation, the producer works

freely, and it is said that in one installation of producers the percentage of CO_2 was only 3·8 per cent. Forced blast is used, even to 30 in. water gauge at times. With a Styrian brown coal a gas of 159 B.TH.U. per cb. ft. was obtained. This producer appears to be well calculated to work steadily and continuously, and produce an even and steady quality of gas without waste of fuel, and with a high efficiency of operation. So far, this producer appears to have been made as a pressure producer, and of large size, but there appears no *primâ facie* reason why the same principles should not be applied to producers of suction type. The air and steam supplies to the producer are controlled separately, and it is stated that the producer will maintain its maximum efficiency when working on dusty, low-grade fuel.

Will.—According to the *Times*, Mr. C. D. Phillips, of Newport, to whose death we referred a short time ago, has left estate valued at £78,188.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The employés of the Leeds Electricity Department held a smoking concert on Saturday at the Grand Central Hotel in order to bid farewell to MR. DICKINSON, the city electrical engineer. The deputy-chairman of the Tramways and Electricity Committee (Ald. Brown) occupied the chair, and during the evening Ald. Tetley presented Mr. Dickinson with two silver standard lamps and a silver cake basket which had been subscribed for by 350 past and present employés of the department. Ald. Tetley referred to the benefit which the city of Leeds had derived from Mr. Dickinson's 20 years' connection with its electricity supply, and referred to the many improvements which he had been instrumental in introducing to the city. Ald. Brown said that after a number of years' intimate connection with Mr. Dickinson, he was of opinion that there was not a better electrician in the country than the manager of the Leeds electricity undertaking. Mr. Dickinson responded, and, after thanking those present for their gifts, said that the Leeds electricity undertaking first started with a 20-KW. dynamo supplying 20 customers. The business had so extended, that now the capital was nearly £1,000,000, and the capacity of the dynamos 15,400 KW., whilst in 1913, when they obtained the new sets, the capacity would be increased to 22,940 KW. He was looking forward to the time when the railways would be electrified, and the use of electric current would be fully appreciated in the household. Mr. Dickinson was released from his duties on January 1st to take up his appointment in Liverpool, on the understanding that he will pay visits to Leeds for consulting purposes.

MR. H. E. MUNDAY, of Shrewsbury electricity works, has been appointed switchboard attendant at H.M. Dockyard, Devonport.

The Burnley Corporation Electricity Committee has recommended that the salary of MR. JAMES E. STARKIE, the electrical engineer, be increased from £400 to £500 per annum, as from January 1st.

MR. A. C. BLACK, formerly shift engineer to the Cleveland and Durham Power Co., Ltd., and now charge engineer at the Bootle electricity works, has been married to Dorothy Edith Halsall, daughter of the late John Charles Halsall, of Liverpool.

MR. W. HODGSON INMAN, for 11 years at the Lancaster Corporation electricity works, has commenced business as an electrical engineer, wiring contractor, &c., at 38, North Road, Lancaster. The staff at the Lancaster Corporation electricity works presented him with a combined ammeter and voltmeter.

MR. C. E. C. SHAWFIELD, electrical and consulting tramway engineer to the Wolverhampton Corporation, has given three months' notice to terminate his engagement, the reason being that he has been offered, and has accepted, a much more important appointment with a new local company, which is as yet in its comparative infancy, but in connection with which it is believed there are great possibilities. Mr. Shawfield went to Wolverhampton from Newcastle, and succeeded Mr. Harman Lewis 15 or 16 years ago as borough electrical engineer, and was later appointed consulting tramway engineer, the combined salary being £600 per annum. He saw the inception in Wolverhampton of the Lorain surface contact system of tramway traction, and under his direction the various routes were laid and equipped. At the present time he is President of the Municipal Electrical Association, and he is also President of the Wolverhampton and District Engineering Co. In this latter capacity he delivered his presidential address less than a month ago.

The Bexley U.D.C. has appointed MR. H. P. STOKES, borough electrical engineer and tramways manager at Ilkeston, as electrical engineer and tramways manager. There were 50 applicants.

The Hastings T.C. has appointed MR. WM. TRAVIS, of Southport, as chief assistant electrical engineer at £150 a year, rising to a maximum of £180.

Tramway Officials.—The Maidstone T.C. has increased the salary of MR. LAMBERT, tramway manager, from £200 to £225 per annum, as from the New Year.

The Darwen Tramways Committee recommends the appointment of MR. F. J. S. HOSKEN as tramway manager, at a salary of £200 per annum.

General.—The following announcement appeared in the *London Gazette* on December 24th :—

ROYAL ENGINEERS.

"London Wireless Telegraph Company, London District Telegraph Companies, Royal Engineers (Army Troops).—LIEUT. AARON E. G. ABRAHAMS resigns his commission. Dated December 25th, 1912.

"Electric Light Company, Dorsetshire (Fortress) Engineers, Royal Engineers.—WILLIAM HENRY UPTON MARSHALL, M.I.E.E., A.M.I.Mech.E., to be Second Lieutenant. Dated December 31st, 1912."

Messrs. Sandycroft, Ltd., announce that they have accepted, with regret, the resignation of MR. W. O. ROOPER, their technical manager. Mr. Rooper is opening offices at 30, College Street, Cannon Street, London, E.C., where he will act as adviser to several well-known mining companies.

MR. H. L. KIRBY JOHNSON, late of Loxley & Co., Ltd., Leeds, has now joined the British Westinghouse Electric and Manufacturing Co., Ltd., and will be attached to the Glasgow branch in charge of the supplies department for Scotland.

The British Westinghouse Co.'s detail department held their annual supper and smoker on the 20th ult., under the chairmanship of Mr. J. Currie, the general foreman of the department. Advantage of the occasion was taken to "send off" MR. H. R. SCHULTZ, the chief switchboard designer, who is leaving to take up an important post in Sweden. He was presented with a gold watch on behalf of the office staff, and with a silver-mounted umbrella by the works staff. A silver *entrée* dish and a pipe also were presented to MR. W. A. COATES, the head of the switchgear sales section, who is leaving for Canada early in the New Year.

MR. R. C. HOUR, of Paris, and MR. C. W. DAVSON, of London, directors of the Warner International and Overseas Engineering Co., Ltd. were passengers by ss. *Carmania*, which left Liverpool on Saturday for New York.

MR. CLAUDE CROMPTON, manager of the lamp shop of Crompton and Co., Ltd., has severed his connection with the company.

The Postmaster-General has appointed MR. W. G. C. KIRKWOOD, Principal Clerk in the Secretary's Office of the Post Office, to be Secretary of the Post Office in Scotland, in place of Sir Edward Redford, C.B., who retired from the service on December 31st.

The *Times* states that MR. ANDREW WILSON TAIT and MR. HARRY FRED LEE ORCUTT have been elected to the board of Fraser & Chalmers.

The marriage took place on December 26th, at Lostwithiel (Cornwall) Wesleyan Church, of MR. THOS. HENRY VARCOE and Miss Martha Jennings, younger daughter of the late Mr. John Jennings, of Restormel, Lostwithiel.

MR. ROLLO APPLEYARD, departmental manager at the works of the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown, has been appointed a Justice of the Peace for West Ham.

In the New Year Honours List we observe that "PAUL JOHANNES BRUHL, Esq., D.Sc., M.I.E.E., F.G.S., F.C.S., Professor of the Civil Engineering College, Sibpur, Bengal," has been appointed to Companionship of the Imperial Service Order. LIEUT.-COL. H. A. YORKE, C.B., Chief Inspecting Officer of Railways under the B. of T. since 1900, receives the honour of knighthood. DR. FRANCIS DARWIN, F.R.S., president of the British Association in 1908, has also been made a knight. Congratulations to these gentlemen.

Obituary.—MR. EDWARD TYER.—We regret to record that the death occurred on Christmas night, in his 83rd year, of Mr. Edward Tyer, of Tunbridge Wells, Assoc. 1861 Inst.C.E., M.I.E.E., F.R.M.S., F.R.G.S., &c., and the funeral took place on Monday last, at Busbridge, near Godalming. The *Times*, in the course of a full obituary of the deceased, published in its issue of December 28th, says that he "did more perhaps than any man now living to ensure by efficient signalling the safety of railways passengers, and . . . . also first gave to the people of London the facilities of telegraphic intercommunication." It appears that his first interest in electrical matters was due to a Mr. Dempster, who kept a private school at Chiswick, and the interest thus begun was easily stimulated, and soon became almost a passion After an attempt at office life, he returned to the interest in electrical apparatus, and in 1852, when he was 22 years of age, he patented an invention "by which an engine driver approaching a station automatically gave to the station inspector an electrical warning of his approach," receiving a reply indicating his right course of action. In association with others he formed the Railway Electric Signals Co., and "invention followed invention, and his system of block signalling became widely known." The *Times* writer continues :—"In 1878 Tyer took out a patent for an improved system of electrical control, which came to be distinctively known as the tablet system, and has been very widely adopted." Further, "he advanced the cause of public telegraphic communication. Before 1859, while trunk lines and cables had their terminal offices in London, they were not linked up with each other. The inhabitants of London could not communicate with each other at all by telegram, and if they wanted to use trunk lines or cables had to go to the offices. Tyer saw the possibility of linking up these offices and of establishing subsidiary offices throughout London from and to which any person could telegraph. The London District Telegraph Co. was formed in January, 1859, under the chairmanship of Samuel Gurney, M.P., with Sir Charles Bright as consulting engineer. To Tyer was given the post of electrical engineer, and the laying down of underground and overhead wires and the manufacture of instruments devolved upon him. Thus was established the foundation of what afterwards was perfected under the

brilliant management of an old signalling competitor, Sir William Preece, and became the postal telegraph service in London, which absorbed all privately-owned systems."

MR. C. H. GADSBY.—We deeply regret to record the death, which has occurred at the early age of 46 years, after a prolonged illness, of Mr. Chas. Herbert Gadsby, Wh.Sch., M.I.E.E., M.I.M.E., consulting engineer, of 20, Victoria Street, London, S.W. He passed away on December 24th, at Farnham, Surrey. Mr. Gadsby began his career as an apprentice at the Falcon Works, Loughborough, and, winning a scholarship, he went to Nottingham University for a year or two, afterwards returning to the Loughborough Works to finish his term. Later he went to Madras for Messrs. Crompton & Co., Ltd., in connection with the electric tramway system there, after which he came home and started as a consulting engineer. He was responsible in that capacity for work done for the British Electric Traction Co., Ltd., the design and construction of the Devonport tramways, and the Burton and Ashby light electric railway for the Midland Railway Co. His death at so early an age is greatly to be deplored.

MR. F. A. HAMILTON.—We learn with regret of the death, which occurred at Halifax, Nova Scotia, on December 19th, at the age of 72 years, of Mr. Frederick A. Hamilton. Mr. Hamilton was born in Kent, England, and in his early years he was in the British Mercantile Marine, and visited Sicily in 1860-69. When Garibaldi was organising an army for the liberation of Rome, he joined Garibaldi's "thousand," landed in Italy, and marched on Rome. The Garibaldians were defeated by the French and Pontifical troops; Hamilton was taken prisoner, and held for some time in "honourable detention" by the Italian Government. The unity of Italy under Victor Emmanuel was subsequently effected and the Garibaldians released. Mr. Hamilton was afterwards employed by the Anglo-Mediterranean Telegraph Co. at Messina, from whence at the end of 1869 he returned to London where he joined the electrical staff of the Telegraph Construction and Maintenance Co., and took part in several cable expeditions in different parts of the world. He first visited North America in the summer of 1872 in the cable ship *Vanessa*, belonging to the same company, which laid cables between Placentia, Newfoundland, and Sydney, Cape Breton Island. During this expedition his left hand was injured, and he entered the French Hospital at St. Pierre, Miquelon, where the thumb was amputated. He afterwards joined the Anglo-American service and was chief electrician of the c.s. *Minia* for nearly 20 years. He resigned from that company and started as a consulting electrician at Halifax, Nova Scotia, and was employed by the United States Government for some time on their c.s. *Burnside* in the extension and maintenance of the inter-island submarine cable systen in the Philippines. After the completion of this work he joined the service of the Commercial Cable Co. as chief electrician of that company's c.s. *Mackay Bennett*, and held that position until his death. Mr. Hamilton probably tested and repaired more broken cables than any other man in the world. He was highly respected, a general favourite, and had a host of friends. Through his residence in Italy he had a great fondness for Italian literature. He was a man of scholarly and artistic tastes, and was conversant with several modern languages. He leaves a widow, a daughter of Judge Johnson, of Halifax, N.S., to mourn his loss.

NEW COMPANIES REGISTERED.

Asuncion Tramway, Light and Power Co., Ltd. (126,196).—Registered December 28th, by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C. Capital, £600,000 in £1 shares (300,000 preference). Objects: To carry on the business of a tramway, light and power company in all its branches, to apply for, purchase or otherwise acquire, work and turn to account, any Parliamentary, municipal or otherconcessions, orders, rights and powers in Paraguay or elsewhere, and to adopt an agreement with the Paraguay Central Railway Co., Ltd. The signatories, (with one share each) are:—F. W. Cowham, 118, Minard Road, Hither Green, S.E., clerk; S. H. Penwarden, 36, Peterborough Road, Leyton, clerk; F. H. Goodwin, 32, Tottenhall Road, Palmer's Green, N., clerk; R. Dolby, 19, Park View Crescent, New Southgate, N., clerk; P. H. Wiggins, 141, Station Road, Finchley, N., clerk; F. J. Prosser, 58, Devonshire Road, Merton, S.W., clerk; A. T. Filer, 89, Helmleigh Road, Stamford Hill, N., clerk. Minimum cash subscripton seven shares. The directors are to number not less than three or more than seven. The Paraguay Central Railway Co., Ltd., have the permanent right to appoint and remove two directors. The other first directors are to be appointed by the signatories; qualification, £200; remuneration as fixed by the company. The company takes power to pay not more than 50 per cent. underwriting commission.

Nu-Lines Manufacturing Co., Ltd. (126,075).—This company was registered on December 20th, with a capital of £3,000 in £1 shares, to acquire and develop the patent and other rights relating to a telephone recorder, a "tell-tale lock," and a calculating machine, the invention of C. C. Chapman, together with the goodwill and assets of the Nu-Lines Manufacturing Co., of Leicester. The subscribers (with one share each) are:—J. Thomas, Rowton Buildings, 11, Bowling Green Street, Leicester, accountant; G. Ineson, 22, Charles Street, Leicester, rag and waste merchant. Private company. The number of directors is not to be less than two or more than five; the first are C. C. Chapman and G. Ineson; qualification, £50. Registered office, 11, Bowling Green Street, Leicester.

J. W. Brettall, Ltd. (126,006).—This company was registered on December 18th, with a capital of £1,000 in £1 shares (500 6 per cent. pref.), to carry on the business of electrical engineers and contractors, and lighting, heating and ventilating specialists, &c. The subscribers (with one share each) are:—J. W. Brettell, 18, Adam Street, W.C., electrical engineer; F. W. S. Napier, Thirlestone, Selkirk, N.B., gentleman. Private company. The first directors are J. W. Brettell and F. W. S. Napier. Registered office, 18, Adam Street, W.C.

McWhirter & Son (Cardiff), Ltd. (126,098).—This company was registered on December 21st, with a capital of £5,000 in £1 shares (3,000 preference), to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, &c. The subscribers (with one share each) are:—A. S. McWhirter, 214, Holm Street, Glasgow, electrical engineer; Annie Heddle, 214, Holm Street, Glasgow, cashier. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. Solicitors, Oatts & Rodger, Glasgow. Registered by Blyth, Dutton, Hartley & Blyth, 112, Gresham House, E.C.

National Electric and Motor Corporation, Ltd. (126,074).—This company was registered on December 20th, with a capital of £500 in £1 shares, to take over the business of the Consolidated Electric Works and Appliances, Ltd. (incorporated in 1909), carried on at Northampton Grove, Canonbury, and the vendors' interest in a British patent granted to G. Ottino for improvements in rotary valve engines. The subscribers (with one share each) are:—J. Crawford, 10, Wine Office Court, E.C., publisher; E. S. Fry, 37, Gondar Gardens, Hampstead, clerk; J. McLaren, 8, Herne Grove, Peckham, S.E., traveller; H. P. Collins, 110, Leigh Road West, Leigh-on-Sea, cigar merchant; T. E. Ward, 2, Wallace Gardens, Canonbury, N., company director; F. H. Shimmell, 30A, Glenfield Road, Balham, S.W., clerk; J. Camp, jun., 14, Serjeants' Inn, E.C., clerk. Minimum cash subscription 25 per cent. of the shares offered to the public. The number of directors is not to be less than two or more than seven; the first are T. E. Ward and four others, to be appointed by the subscribers; qualification, 100 shares. Registered by C. Doubble, 14, Serjeants' Inn, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

United Sherardizing, Ltd.—Particulars of £10,000 debentures, created September 2nd, 1912, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £2,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Grindell-Matthews Wireless Telephone Syndicate, Ltd.—Charge on company's undertaking and property, present and future, dated December 9th, 1912, to secure a premium of 10 per cent. upon an issue of £2,500 debentures, part of a series of £3,800. Holder: Otto Beit, Warnford Court, E.C.

White Bros. & Shaw, Ltd.—Debenture dated November 25th, 1912, to secure £300, charged on the company's undertaking and property, present and future. Holder: Miss I. A. Andrews, Fair View, Alvestoke, Hants.

Yorkshire Waste Heat Co., Ltd.—Particulars of £25,000 debenture stock, created December 3rd, and secured by trust deed dated December 4th, 1912, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908; the whole amount being now issued. Property charged: Land in Barugh Parish, Yorks., with buildings thereon, present and future, &c. (Power is reserved to release part of the mortgaged property, if trustees are satisfied that stockholders' security will not be prejudiced.) Trustees: F. J. Kitson, Gledhow Grove, Leeds; and H. I. Bowring, Blackwood Moor, Allerton.

Argentine Tramways and Power Co., Ltd.—Trust deed dated December 2nd, 1912, to secure £250,000 debenture stock, charged on the company's undertaking and property, present and future, including uncalled capital (if any). Trustees: C. W. Trotter, Basildon House, Moorgate Street, E.C., and W. S. Poole, 8, Princes Street, E.C.

Acton Lamp, Ltd.—Issue on December 11th, 1912, of £800 debentures, part of a series of which particulars have already been filed.

New Phonopore Telephone Co., Ltd.—Capital £10,000 in 9,000 ord. and 1,000 founders' shares of £1 each. Return dated November 7th, 1912; 7,141 ord. and 1,000 founders' shares taken up; £1 per share called up on 6,141 ord. and 600 founders' shares; £6,731 paid, leaving £10 in arrears; £1,400 considered as paid on 1,000 founders' and 400 ord. Mortgages and charges: £3,700.

Pacific and European Telegraph Co., Ltd.—Capital £100,000 in £10 shares. Return dated November 26th, 1912. All shares taken up; £4 per share called up; £40,000 paid. Mortgages and charges: £72,400.

New St. Helens and District Tramways Co., Ltd.—Capital £150,000 in £5 shares (20,000 pref., and 10,000 ord.). Return dated November 9th, 1912. 15,980 pref. and 9,000 ord. shares taken up. £125,410 paid, including £510 on 1,020 forfeited shares. Mortgages and charges: Nil.

Ferranti, Ltd.—Trust deed dated November 1st, 1912, supplemental to trust deed dated July 24th, 1905, and February 25th, 1910, securing £50,000 5 per cent. first mortgage debenture stock charged on leasehold hereditaments and premises in Failsworth and the company's undertakings and property, present and future, including uncalled capital. Trustees:—H. R. Boyce, Winchester House, E.C., and W. Jones, manager of Parr's Bank, Manchester. Also trust deed of even date to secure £50,000 500 five-year notes of £100 each carrying interest at 6 per cent. per annum, charged on above-mentioned 5 per cent. first mortgage debenture stock. Trustees: Trust Union, Ltd., 18, Austin Friars, E.C.

Titchfield and District Lighting, Ltd.—A memorandum of satisfaction to the extent of £900 on December 14th, of debentures dated February 27th, 1912, securing £2,500, has been filed.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £2,300 on December 18th, 1912, of trust deed and supplemental deeds dated from July 27th, 1904, to October 27th, 1909, securing £200,000 debenture stock, has been filed.

Oriental Telephone and Electric Co., Ltd.—A memorandum of satisfaction to the extent of £1,000 on December 18th, 1912, of trust deed and supplemental deed of acknowledgment dated June 28th, 1905, and June 11th, 1907, respectively, securing £200,000, has been filed.

CITY NOTES.

Metalite, Ltd.

MR. W. STEWART (chairman) presided on Tuesday at 20-22, Christopher Street, E.C., over the second annual meeting of the Metalite Co. There was no report or accounts presented, as it was stated in the notice convening the meeting that the audit was not complete, and it was proposed to adjourn the meeting till February 28th. There were about 20 shareholders present.

The CHAIRMAN said: Ladies and gentlemen, this meeting has been called solely to comply with the terms of the Companies' Consolidation Act, 1908, which necessitates an annual general meeting being held before the end of the calendar year. You will remember that, at the last annual general meeting, a point was made of the fact that this company had then secured the option of the purchase of the exclusive rights in this country for the production of a new filament, which the directors believe will be better than any other existing filament. You will be glad to hear, therefore, that the negotiations have been satisfactorily concluded, and that this company now hold the sole licence for the United Kingdom to manufacture the filament known as the Boran filament. Prior to signing the contract, a great deal of experimental work was done in our own laboratory, and the directors feel assured that once in the position to put the lamps in large quantities on the market, they are on the right road for making a substantial profit. Owing to a notice in a journal, the company has been practically inundated with orders for this new lamp, and it seems only a matter of the company having sufficient funds to turn out the lamps in regular quantities in order to yield very handsome results. For all practical purposes, the manufacture of the new lamp commenced from November 1st, 1912, and thus the directors considered it best that the accounts for the present financial period should be made up to October 31st instead of July 31st, and it is for this reason that we propose to put a resolution to the meeting asking them to adjourn it until February 28th next, when the accounts will be available, and I shall then have much pleasure in giving full particulars regarding them. However, I regret to add that owing to exceptional difficulties and lack of financial resources, the directors will not be able to recommend the payment of a dividend for such period. I now beg to move that this meeting do stand adjourned until Friday, February 28th next, at this warehouse at 11.30.

MR. LEE (a shareholder) seconded the motion.

MR. HARRISON: I will propose an amendment, that the meeting be not adjourned until a Committee of inquiry, or some inquiry into the accounts of the company is made.

A DIRECTOR: That amounts to a direct negative.

The motion was then put and carried, with three dissentients.

The CHAIRMAN: I declare this meeting adjourned accordingly until February 28th next.

MR. HARRISON: Can I ask further questions on the position of the company?

The CHAIRMAN: The meeting is now concluded.

MR. HARRISON: But outside the meeting?

The CHAIRMAN: Mr. Harrison, if you will come to me I shall be pleased to answer questions.

MR. HARRISON: I have asked previous questions and got no satisfaction. This is a serious matter.

MR. DUNLOP (a shareholder): This is quite irregular. If this gentleman wants any information, he is able to ask you for it. It is not to the interests of any member of this company that any person should get up and make statements which may be calculated to injure our interests. We are here to consider our own interests, and I object to allowing any gentleman to injure them, and if it is information he really wants, he can easily obtain it by acquiring it at the proper place.

MR. HARRISON: No, Mr. Dunlop, I can't.

A SHAREHOLDER: Mr. Stewart, allow me to congratulate you on your successful tactics.

The meeting then closed.

Bryant Trading Syndicate, Ltd.—The annual meeting of this company was, we understand, held at 8-9, Broad Street Avenue, London, E.C., on Tuesday, and was adjourned until March 7th. In a circular issued under date December 23rd, signed by "Wm. Stewart," it was stated:—"The reason the directors desire the meeting to be adjourned is that they have certain plans and negotiations on hand which will, I believe, mature during the next two months, and which they consider would be of benefit to the shareholders of this syndicate." After referring to other matters in which the syndicate is interested, the circular continued:—"With regard to Metalite shares, as you are aware, we still hold some 30,000 fully-paid shares in this company, in addition to 60,000 partly paid, and as Metalite, Ltd., are in the fortunate position of having a new lamp and in view of the large number of orders offered them, it is believed that they will shortly be sufficiently financed to place them in a sound position, so that that part of the assets of this company should be of considerable value. In conclusion, I wish to point out that my co-directors with myself, in view of their belief in the ultimate success of this company, have personally assisted by way of loans in addition to giving their personal guarantee in many matters in order to enable the company to continue and with a view of its ultimate success, this personal liability amounting to over £20,000." The circular is signed "Yours fraternally."

Blackpool, Lytham and St. Annes Tramways Co.

AT the annual meeting at Blackpool, on Monday last week, Mr. George Nicholson (Liverpool), who presided, said they could not congratulate themselves on the result of the year's working. The year opened with great encouragement, the receipts for the first six months being £1,079 up, but unsettled weather for four months in the summer season caused a decrease in revenue of £2,968, while the expenditure had increased by £1,377 on account of upkeep of permanent way, so that there was a shortage of £1,100, as compared with 1911. He complained that the Corporation of Blackpool charged them 2d. per unit for electrical energy, whereas the average price all over the country was 1·40d. per unit. It was absolutely essential, he continued, that they should renew a portion of the track at a cost of £2,000. They had to face increased cost of materials, and the additional burden imposed by the Insurance Act. The report was adopted, and Mr. T. Blane, of Blackpool, was re-elected chairman of directors. Arising out of a portion of the report announcing that the trustees of the debenture-holders, upon the recommendation of the directors, had intimated their intention of paying 1½ per cent. on account of the arrears of interest due on the debenture stock, and to enable this payment to be made, the annual payment to the sinking fund had been suspended for the year, an animated discussion took place, led by Mr. Thos. Preston, of St. Annes, who suggested that the Blackpool Corporation should take over the tramway. It was, he said, utterly illogical and absurd that shareholders should come to a meeting to manage a concern in which they had not a farthing's worth of interest. The Chairman said the debenture-holders were entitled to the line until they were paid out, and in view of the cost of the line, and the great interest arrears, he thought there was no chance of the shareholders getting a penny. A committee of shareholders was appointed to confer with the directors, to see if some improved position could be devised.

Mexican Fuel and Power Co.—The directors' report for the year ended September 30th last, states (according to the *Financial News*) that the company having been engaged upon construction work only during the period covered by the report, no profit and loss account is submitted. The issued capital of the company is £70,000 in 20,000 preference shares of £1 each, and 50,000 ordinary shares of £1 each, leaving 30,000 preference shares in reserve. In December, 1911, the company acquired from the vendors, the Peat Industry Co., a concession granting rights over the large peat deposit situated at Lake Xochimilco, about 12 miles from Mexico City. The area covered by the concession is over 7,000 acres, and contains a practically inexhaustible supply of raw peat. The company also acquired certain plant and machinery for the manufacture of fuel from this peat. The amount expended by the Peat Industry Co. prior to the incorporation of this company on plant, machinery, &c., was estimated at £37,000, and the accounts show a further sum of £9,360 expended up to September 30th, 1912, on additional buildings, machinery, power, plant, &c. The work of erecting the additional plant has been carried on energetically, in the face of considerable difficulties and delays due to the political disturbances in Mexico. The work is now almost completed. The directors anticipate that as soon as the plant is in full working order an output of about 50 tons of fuel a day may be expected. Already several inquiries have been made for the company's products in substantial quantities.

Stock Exchange Notices.—Application has been made to the Committee to allow the following security to be quoted in the Official List:—

Cordoba Light, Power and Traction Co., Ltd.—Further issue of 127,553 ordinary shares of £1 each fully paid.

The Committee has (1) appointed special settling days as under:—

Wednesday, January 8th.—British Columbia Electric Railway Co., Ltd.—Further issue of £200,000 deferred ordinary stock; £200,000 preferred ordinary stock; and £200,000 5 per cent. cumulative perpetual preference stock.

Thursday, January 16th.—Compania de Electricidad de la Provincia de Buenos Ayres, Ltd.—Further issue of £150,000 5 per cent. first mortgage gold bonds of £20 each (Nos. 37,501 to 45,000).

And (2) ordered the undermentioned securities to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—Further issue of £200,000 deferred ordinary stock; £200,000 preferred ordinary stock; and £200,000 5 per cent. cumulative perpetual preference stock.

New York Telephone Co.—£250,000 additional 4½ per cent. first and general mortgage bonds of £100 each (Nos. C37,501 to 40,000).

Continental.—GERMANY.—The report of the A.E.G. Lahmeyer-Werke Gesellschaft, of Frankfort-am-Main, for the last financial year shows a profit of £31,960, as compared with only £28,867 in the preceding 12 months. A dividend of 6 per cent. is being declared.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—The directors have declared a dividend of 1¼ per cent.

Sao Paulo Tramway, Light and Power Co., Ltd.—The directors have declared a dividend of 2½ per cent.

MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, January 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	per lb.	2¾d.	..
a „ Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	„	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16 10	..
a Copper Sulphate	„	£25 10	..
a Lead, Nitrate	„	£29 10	£1 10s. inc.
a „ White Sugar	„	£25 10	..
a „ Peroxide	„	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (88/90 %)	per ton	£22 10	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	„	7½d.	..
a Shellac	per cwt.	72/6	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70/72 %)	„	£10 5	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£95	..
b „ Wire, in ton lots	„	£112	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£88 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	9d.	..
c „ Tube (brazed)	„	10½d.	..
c „ „ (solid drawn)	„	9½d.	..
c „ Wire, basis	„	9d.	..
c Copper Tubes (brazed)	„	1/0½d.	..
c „ „ (solid drawn)	„	11½d.	..
g „ Bars (best selected)	per ton	£92	£2 inc.
g „ Sheet	„	£92	£2 inc.
g „ Rod	„	£92	£2 inc.
d „ (Electrolytic) Bars	„	£82	..
d „ „ Sheets	„	£99	..
d „ „ Rods	„	£87	..
d „ „ H.C. Wire	per lb.	10⅝d.	..
f Ebonite Rod	„	5/8	..
f „ Sheet	„	4/9	..
n German Silver Wire	„	1/10	..
h Gutta-percha, fine	„	..	..
h India-rubber, Para fine	„	4/7	1d. inc.
l Iron Pig (Cleveland warrants)	per ton	67/5	8d. inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Pig	„	£18 5 to £18 10	dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7 8 6	..
e Mica (in original cases) small	per lb.	6d. to 8s.	..
e „ „ „ medium	„	3/6 to 6/-	..
e „ „ „ large	„	7/6 to 11/-	..
p Phosphor Bronze, plain castings	„	1/2 to 1/4	..
p „ „ rolled bars & rods	„	1/2	..
p „ „ rolled strip & sheet	„	1/2½	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	11½d.	..
Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£231 10 to £232 10	£2 inc.
n „ Wire, Nos. 1 to 16	per lb.	2/9	..
p White Anti-friction Metals	per ton	£45 to £230	..
k Zinc, Sh's (Vieille Montagne bnd.)	„	£31 12 6	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Llandudno and Colwyn Bay Electric Railway Co., Ltd.—The directors report that the profit for the year to November 30th, 1912, after providing for operating and administration expenses and interest on debenture stock, amounts to £6,023. The amount brought forward from last account was £714, making (says the *Financial News*) a total available balance of £6,737. Part of this amount has been applied as follows:—In placing to depreciation reserve account (making a total to date of £4,000), £1,000; in writing off part of discount and expenses of issue of debenture stock, £1,000, leaving £4,737, which the directors recommend should be applied as follows:—In payment of a dividend at the rate of 3½ per cent. per annum (payable, less income-tax, on January 31st, 1913), £3,479, leaving to be carried forward £1,258. The traffic receipts show an increase of £840 over the previous year.

STOCKS AND SHARES.

Tuesday Evening.

THE old year finishes up this Tuesday evening, and therefore it is possible to bring our usual lists of comparisons right up to date. Week by week the various features in the markets connected with electrical issues have been duly chronicled, and it remains now only to show the rises and falls during the period and to offer regretful apologies for such sins of commission and omission as have crept in or out of these weekly articles throughout the time.

With which prefatory sentences, let us proceed to unfold the various lists, taking first of all that which embraces the Electric Railway issues. There has been more excitement in these than in any other market, as a whole, connected with the electrical industry, and the extension of the Speyer control has had the effect, it will be noticed, of sharply advancing most of the prices concerned:—

Stock or share.	Jan. 2nd.	Dec. 31st.	Rise or fall.
Central London Railway, Ordinary	69	83	+ 14
„ „ Preferred	85	84	— 1
„ „ Deferred	58	83	+ 25
City and South London, Ordinary	31	36½	+ 5½
Metropolitan Railway, Consol	40½	63½	+ 6⅝
Metropolitan District, Ordinary	35	40⅝	+ 5⅝
Metropolitan Electric Trams, Ordinary	⅞	1¼	+ ⅜
Underground Electric Railways	3⅜	4⅛	+ 1⅛
„ „ „ 6 % Income	78	93	+ 15

Prices have been considerably higher than those set out in the second column above, but they still show material improvement on balance.

Advances, too, are general in the list of electricity supply shares, where sentiment has been swayed by rumours of a general agreement between the companies and the local authorities, as to which no details are yet available. There was much gambling in City of London shares during the summer, but just lately speculation has died down in them to a large extent, and the price has dwindled at the same time. The following shows the course of the market in the Ordinary shares of some of the leading companies:—

Ordinary Share.	Jan. 2nd.	Dec. 31st.	Rise or fall.
Brompton and Kensington	8½	9	+ ⅞
Charing Cross, West End and City	3½	4⅞	+ 1⅜
Chelsea	4¼	4⅝	+ ⅜
City of London	12⅝	17	+ 4⅜
County of London	9⅛	11⅜	+ 2⅛
Kensington and Knightsbridge	7	7⅝	+ ⅝
London Electric	1⅝	1⅞	+ ¼
Metropolitan	3⅝	3⅝	—
St. James' and Pall Mall	8¼	9⅞	+ 1⅝
Westminster	8⅝	9	+ ⅜

Some of the biggest movements in prices have occurred in the Latin-Canadian section, where there has been plenty of business for the greater part of the year, and where those who got in early have been able to take splendid profits. Here again, however, quotations have shown a tendency to sag during the last month or so. Several important schemes of amalgamation have been successfully carried through—the Brazilian Traction Company, for instance, is the outcome of the consolidation of three others—and this is a policy that is likely to be extended. Here are a few of the figures:—

Stock or share.	Jan. 2nd.	Dec. 31st.	Rise or fall.
Anglo-Argentine Tram. First Pref.	5⅞	4⅞	— ⅛
British Columbia Electric Def.	138½	141½	+ 3
Canadian General Electric, Com.	112½	115	+ 2½
Mexican Light and Power, Com.	90	85	— 5
Mexico Tramways, Com.	125	112	— 13
Montreal Light, Heat and Power	198	229½	+ 31½
Shawinigan Water, Capital	127	145	+ 18

Marconi's have been up to 9¾ and down to 3¼, finishing the old year at 4¾, a rise of 30s. on balance. National Telephone Deferred has experienced remarkable adventures, too, flying between 162 and 120, although the net result of the year is a rise of no more than 7½ points. This, with certain other representative examples in the Telegraph market, is shown in the following brief table:—

Stock or share.	Jan. 2nd.	Dec. 31st.	Rise or fall.
Anglo-American Telegraph Deferred	26¼	26	— ¼
Eastern Telegraph Ordinary stock	139½	134½	— 5
Eastern Extension	13½	13½	—
Marconi Wireless Telegraph	3¾	4¾	+ 1
National Telegraph Deferred	131	138½	+ 7½
West India and Panama Telegraph	3⅛	3⅜	— 1/16

The manufacturing division has jogged along in rather unexciting fashion, as six or seven of the principal shares will suffice to illustrate:—

Share.	Jan. 2nd.	Dec. 31st.	Rise or fall.
Babcock & Wilcox	6¼	3 3/16	+ 1/16
Callender's Cable	9⅜	10⅛	+ 1/16
Dick, Kerr & Co.	1 1/16	1 1/16	—
General Electric Preference	9	10¼	+ 1¼
Henley's Ordinary	12¼	12⅝	+ ⅜
India-Rubber, G.-P. & T.	11	10	— 1
Telegraph Construction	35	35½	+ ½

Remains it now, but to add the cordial, if conventional, hope of a very prosperous New Year to all who have the patience, and the fortitude, to follow the electrical industry and its industrious—more or less—pen-pushers.

Chili Telephone Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum (3s. per share) for the past half-year.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 31st.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bournemouth & Poole, Ord.	10	5⅛	5†	9⅛ — 10⅜	..	5 4 9
Do. 4½ % Pref.	10	4½	4½	8¾ — 9⅜	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10 — 10¾	..	5 14 8
Do. 4½ % Deb. Stock	Stock	4½	4½	96 — 98 xd	..	4 11 10
Brompton & Kensington, Ord.	5	10	9†	8⅜ — 9⅛	..	5 8 1
Do. 7 % Cum. Pref.	5	7	7	8¼ — 9	..	3 17 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	95 — 98	..	4 1 8
Charing Cross, West End & City	5	5	5†	4⅜ — 5⅛	..	4 17 7
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅜ xd	..	5 2 10
Do. Do. 4 % Deb.	100	4	4	92 — 94	..	4 5 1
Chelsea, Ord.	5	5	4†	4⅛ — 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	96 — 99 xd	..	4 10 11
City of London, Ord.	10	8	6†	16 — 18	..	4 9 0
Do. 6 % Cum. Pref.	10	6	6	12 — 13½	..	4 9 0
Do. 5 % Deb.	Stock	5	5	116 —120	−2	4 3 4
Do. 4½ % Second Deb.	100	4½	4½	99 —101	−1½	4 9 1
County of London, Ord.	10	6	4†	11⅛ — 12	..	5 0 0
Do. 6 % Pref.	10	6	6	11⅜ — 12½	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	103 —105 xd	..	4 5 9
Do. 4½ % Second Deb.	Stock	4½	4½	98 —101	..	4 8 3
Edmundson's, Ord.	£3	Nil	..	5/16 — 9/16	—1/16	Nil
Do. 6 % Cum. Pref.	5	Nil	3	4 — 4⅜	— ⅛	..
Do. 6% Non-Cum. Pref.	5	..	..	1⅛ — 1⅜	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅜ — 5⅛	..	5 17 1
Do. 5 % Cum. Pref.	5	5	5	4⅜ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	92 — 95	..	4 14 9
Hove	5	9	8†	7⅞ — 8	..	5 12 6
Kensington & Knightsbridge, Ord	5	9	8†	7⅝ — 8⅛	..	5 10 9
Do. 4 % Deb.	Stock	4	4	92 — 95	..	4 4 3
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	3	2½	..	1¼ — 2	..	3 15 0
Do. 6 % Pref.	5	6	6	4¾ — 5¼	..	5 14 8
Do. 4 % First Mort. Deb.	Stock	4	4	88 — 91	..	4 8 0
Metropolitan	5	4	4†	3⅜ — 2⅞	..	5 3 3
Do. 4½ % Cum. Pref.	5	4½	4½	4 — 4⅜ xd	..	5 2 10
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 —100 xd	..	4 10 0
Do. 3½ % Mort. Deb.	Stock	3½	3½	84 — 86 xd	..	4 1 5
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	97 — 99 xd	..	4 10 11
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜ — 4⅞	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgage (Red.)	100	5	5	98½ —101½	..	4 18 6
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9½ — 10½ xd	..	5 11 7
Oxford	5	7½	6†	6½ — 6⅞	..	5 9 6
St. James' and Pall Mall, Ord.	5	10	10†	9½ — 10½	..	4 17 7
Do. 7 % Pref.	5	7	7	6⅝ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	84 — 87 xd	..	4 0 6
Smithfield Markets, Ord.	5	2	..	1⅜ — 1½	..	..
South London, Ord.	4	5	..	2⅜ — 3⅜	..	5 18 4
Do. 5 % First Mort. Deb.	100	5	5	96 — 99 xd	..	5 1 0
South Metropolitan, 7 % Pref.	1	7	7	1⅝ — 1⅞	..	5 9 5
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	..	4 11 3
Urban, Ord.	£3	Nil	..	1/16 — 3/16	..	..
Do. 5 % Cum. Pref.	5	2	‡	2⅜ — 3⅛	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88	..	5 2 3
Westminster, Ord.	5	10	9†	8⅞ — 9½	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 5⅛ xd	..	4 7 10

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅝	..	5 6 8
Calcutta, Ord.	5	8½	7†	6⅝ — 7⅛	..	5 19 4
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16	..	4 16 5
Calgary Power, 1st Mort. Bds.	100	5	5	94½ — 96½	+ ½	5 3 8
Canadian Gen. El. Com.	$100	7	7	118 —117 xd	−1½	5 19 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	8	5	13/16 — 15/16	..	5 6 8
Do. 5 % Deb.	100	5	5	95 — 98	..	5 2 0
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	92 — 94	..	6 7 8
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84 — 87 xd	..	5 14 11
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	95½ — 97½	..	5 2 7
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	3/16 — 5/16	..	Nil
Do. 6 % Pref.	1	6	6	15/16 — 1 1/16	..	8 14 6
Kaministiquia Power, 5 % G. Bs.	$500	5	5	104 —106	..	4 14 4
Madras, Ord.	5	Nil	..	1⅜ — 2	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	100 —103 xd	..	4 17 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	87 — 89	+ ½	5 12 4
Mexican Lt. & Power, Common	$100	4	4†	88½ — 86½	..	4 12 6
Do. 7 % Cum. Pref.	$100	7	7	109 —106	..	6 12 1
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95 — 97	..	5 3 1
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	86½ — 88½	+1	5 13 0
Montreal, Lt., H. and Power	$100	8	9†	227 —232	..	3 17 7
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5a	25 — 30	..	..
River Plate, Ord.	Stock	10	..	225 —235	..	4 5 1
Do. 6 % Non-Cum. Pref.	Do.	6	6	106 —111	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	100 —102 xd	..	4 18 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	98 —100	..	4 10 0
Shawinigan Water, Capital	$100	5	5	143 —147	+4	3 8 0
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	100 —102	..	4 8 3
Toronto Power, 4½ % Deb.	Do.	4½	4½	98½ —100½	+1	4 9 7
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	93½ — 96½	..	5 3 8
Victoria Falls Power, Pref.	1	11¼d.	17½d.	3/16 — 5/16	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	103½ —105½	..	5 13 9

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	4	4½†	7 — 7½	..	6 0 0
Do. 5 % Deb. Red.	Stock	5	5	97 — 99	..	5 1 0
American Telep. & Teleg., Cap.	$100	8	8†	141 —143 xd	+ ½	5 11 11
Do. Collat. Trust	$1000	4	4	98 — 95	..	4 4 8
Anglo-American Telegraph	Stock	8	8	67 — 69	..	4 7 0
Do. 6 % Pref.	Do.	6	6	111 —112	+ ½	5 7 2
Do. Def.	Do.	30/-	..	25/8 — 26/8	+ 1/4	5 14 10
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	7	8	7½ — 7⅝ xd	..	5 3 3
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	80 — 82 xd	+1½	4 17 7
Cuba Telegraph	10	6	6†	8½ — 9½	..	6 6 4
Do. 10 % Pref.	10	10	10	16 — 17	..	5 17 8
Direct Spanish Telegraph, Ord.	5	4	4†	8¼ — 8⅜	..	5 6 8
Do. 10 % Cum. Pref.	5	10	10	6⅞ — 7	..	7 2 10
Direct United States Cable	10	5	4	7 — 7½	..	6 13 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101 xd	+2½	4 9 0
Eastern Telegraph, Ord. Stock	Stock	7	7†	133 —136	..	5 3 0
Do. 3½ % Pref. Stock	Do.	3½	3½	77 — 79	..	4 8 7
Do. 4 % Mort. Deb.	Do.	4	4	96 — 98	..	4 1 8
Eastern Extension	10	7	7†	13 — 13½	..	5 3 8
Do. 4 % Deb.	Stock	4	4	96 — 98	..	4 1 8
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	98 — 101	..	3 19 8
Globe Telegraph and Trust	10	6	6†	10⅜ — 10⅞	..	5 10 4
Do. 6 % Pref.	10	6	6	12⅜ — 12⅝	..	4 18 2
Great Northern Telegraph	10	18	18	27½ — 29½	..	6 2 0
Indo-European Telegraph	25	13	5†	56 — 58	..	6 12 1
Mackay Companies Common	$100	5	5	85 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	67 — 70	..	5 14 4
Marconi's Wireless Telegraph	1	20	..	4⅛ — 4⅜	+ ⅛	4 3 4
Do. 7 % Cum. Partic. Pref.	1	17	..	4 — 4¼	+ ⅛	4 0 0
Monte Video Telephone, Ord.	1	6	6†	1⅝ — 1¾	..	5 13 0
Do. 5 % Pref.	1	5	5	3/16 — 5/16	..	5 18 6
National Telephone Def.	Stock	6	..	137 — 140	..	..
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	97½ — 98½	..	4 11 2
Oriental Telep. and Elec.	1	8	6†	13½ — 14⅝	..	4 9 10
Do. 6 % Cum. Pref.	1	6	6	1 3/16 — 1 5/16	..	4 18 6
Do. 4 % Red. Deb.	Stock	4	4	87 — 89 xd	..	4 8 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100 xd	+2	4 0 0
Reuter's	10	10	10†	10½ — 11	..	9 1 10
Submarine Cables Trust	Cert.	6	6	127 —130	..	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	97 —99 xd	..	4 10 11
United River Plate Telephone	5	8	..	7 7/16 — 7 9/16	—1/16	5 4 1
Do. 5 % Cum. Pref.	5	5	5	5 5/16 — 5 7/16 xd	+ 1/16	4 7 11
West Coast of America	2½	2½	..	1 5/16 — 1 7/16	..	4 0 0
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	96½ — 99½	+ ½	4 0 5
West India and Panama Teleg.	10	2½	1½†	3 — 3½	..	..
Do. 6 % Cum. 1st Pref.	10	6	6	10½ — 10⅝	..	5 13 8
Do. 6 % Cum. 2nd Pref.	10	6	6	9½ — 10	..	6 0 0
Do. 5 % Debs.	100	5	5	101 —103 xd	+1	4 17 1
Western Telegraph, Ltd.	10	7	7†	13 — 13½ xd	+ ½	5 3 8
Do. 4 % Deb.	Stock	4	4	94 — 96 xd	+ ½	4 3 4
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	97 —100	..	4 10 0

* Unless otherwise stated, all shares are fully paid. a Paid in deferred interest warrants. † Interim Dividend. ‡ 8s. in Funded Dividend Certs

CONTINUED ON NEXT PAGE.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 31st.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	3/16 — 5/16	..	Nil
Do. 5 % Pref.	1	5	5	15/16 — 1 1/16 xd	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	76 — 81	..	5 11 1
Brit. Elec. Trac., 6 % Pref.	100	..	..	11½ — 13½	..	..
Do. Do. Deferred	100	..	..	5 — 7	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	87 — 90	..	6 13 4
Do. 7 % Non-Cum. Pr'f.	100	..	..	89 — 92	..	..
Do. 5 % Perp. Deb.	100	5	5	92 — 96	..	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	77 — 81	..	5 7 2
Central London Railway, Ord.	100	8	8†	82 — 84	+1	3 11 5
Do. Pref.	100	4	4	83 — 85	..	4 14 2
Do. Def.	100	2	..	82 — 84	+2	2 7 7
Do. 4 % Deb.	100	4	4	98 —100 xd	..	4 0 0
City & South London, Ord.	100	1⅜	1⅜†	36 — 37	+1	3 14 4
Do. 5 % Pref., 1891	100	5	5	109 —111	..	4 10 1
Do. Do. 1896	100	5	5	109 —111	..	4 10 1
Do. Do. 1901	100	5	5	109 —111	..	4 10 1
Do. Do. 1908	100	5	5	109 —111	..	4 10 1
Do. 4 % Deb.	100	4	4	98 —100	..	4 0 0
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	2⅛ — 2⅜	..	Nil
Hastings Trams, 6 % Pref.	1	6	6†	13/16 — 15/16	..	8 6 8
Do. 4½ % Deb.	100	4½	4½	69 — 74	..	6 1 7
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2½ — 2⅝	..	4 15 3
Do. 4 % Deb.	100	4	4	75 — 96 xd	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	78 — 80 xd	..	6 5 0
London Elec. Railw'ys, 4 % Deb.	100	4	4	94 — 96 xd	..	4 3 4
London United Trams, 5 % Pref.	10	Nil	..	5 — 6	..	..
Do. 4 % Deb.	100	4	4	69 — 72 xd	—1	5 11 1

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 31st.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	100	1⅞	1½†	53 — 53⅓	+1½	3 0 9
Do. Surplus Lands	100	2⅝	2½†	62 — 64	..	4 6 0
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 19 3
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	40⅜ — 41	+ ⅛	Nil
Do. 6 % Deb.	100	6	6	139 —141 xd	+1	4 4 0
Do. 4 % Deb.	100	4	4	93 — 95 xd	..	4 2 6
Do. 4 % Prior Lien	100	4	4	99 —101	..	3 19 3
Do. 4½ % First Pref.	100	4½	4½	88 — 90	..	5 0 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	6	5†	1 1/16 — 1 3/16	..	5 1 1
Do. Def.	1	Nil	..	1/16 — 1/8	..	Nil
Do. 5 % Pref.	1	5	5	2/3 — 3/4	..	5 14 3
Do. 4½ % Deb.	100	4½	4½	91 — 93 xd	..	4 14 9
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Potteries, Ord.	1	3½	..	5/16 — 7/16	..	..
Do. 5 % Pref.	1	5	5	13/16 — 15/16	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	85 — 88	..	5 2 3
South Metro. Trams, 6 % Pref.	1	6	..	1⅛ — 1⅜	..	7 7 8
Do. 4 % Deb.	100	4	4	65 — 70 xd	..	5 14 4
Underground Elec. Railways	10	..	..	4⅜ — 4⅝	..	Nil
Do. "A"	1/-	..	..	1/16 — 1/8	..	..
Do. 6% First Cum. Inc. Deb.	100	..	6	111 —113	..	5 6 2
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	100	1½	£2	92½ — 93½	+ ½	..
Yorkshire (West Riding), Ord.	5	Nil	..	1/16 — 3/16	..	Nil
Do. 6 % Pref.	5	3	3†	3 — 3 1/16 xd	..	4 5 9
Do. 4½ % Deb.	100	4½	4½	77 — 81 xd	..	5 8 5

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4⅜ — 5 xd	..	5 10 0
Do. 2nd Pref.	5	5½	5½	4 15/16 — 4 15/16 xd	..	5 14 8
Do. 4 % Deb.	100	4	4	92 — 94 xd	..	4 5 1
Do. 4½ % Deb.	100	4½	4½	97 — 99 xd	..	4 10 11
Do. 5 % Deb.	100	5	5	98 — 100	+ ½	5 0 0
Auckland Trams, 5 % Deb.	100	5	5	101 —103 xd	..	4 17 1
Bombay Elec. S. & Trams, Pref.	10	6	6	11⅛ — 12½	..	4 18 0
Do. 4½ % Deb.	100	4½	4½	96 — 98 xd	..	4 11 10
Do. 5 % 2nd Deb.	100	5	5	99 —101	..	4 19 0
Brazilian Traction Light and Power	$100	..	..	93½ — 95⅛	+2½	..
Brisbane Trams Invt., Ord.	5	8	8†	7 1/16 — 7 5/16	..	5 9 5
Do. 5 % Pref.	5	5	5	4⅝ — 5⅞	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	99 —102 xd	..	4 8 3
B. Columbia Elec. Rly., Def.	100	8	..	139 —144	..	5 11 2
Do. Pref. Ord.	100	6	6	118 —122	+1	4 18 4
Do. 5 % Pref.	100	5	5	107 —110	+ ½	4 10 11
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98½ —101½	..	4 8 8
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	97 —100	..	4 5 0
Calcutta Trams, Ord.	5	7	5†	5⅝ — 6⅛	..	5 14 8
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16 xd	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	97 —100	—2	4 10 0
Cape Electric Trams	1	2½	..	3/16 — 5/16	..	..
City Buenos Aires Trams (1904)	5	5	5†	5 1/16 — 5 1/8	..	4 8 0
Do. 4 % Deb.	100	5	5	97 —100 xd	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	98 — 97	..	5 3 1
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	3/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	83 — 88 xd	..	5 13 8
Do. 6 % B Deb.	100	6	3	30 — 40	..	..

La Plata Elec. Trms, Ord.	1	Nil	..	17/32 — 21/32	..	..
Do. Pref.	1	6	..	29/32 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1 — 1⅛	..	4 16 0
Do. 6 % Pref.	1	6	6	1 — 1⅛ xd	..	4 16 0
Do. 5 % Deb.	100	5	5	98 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	98 —100 xd	..	5 0 0
Manaos Trams & Lt., 1st Deb.	100	5	5	83 — 92	..	5 8 8
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100¾ —102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	111 —113	+2	6 3 11
Do. Gen. Con. 5 % Bonds	..	5	5	96 — 98	+ ⅛	5 2 0
Do. 6 % Bonds	100	6	6	103 —105	+1⅛	5 14 3
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7¼ — 7⅜	+ ⅛	6 9 0
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	97⅛ — 99½	+ ⅛	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	5	5⅓	1 3/16 — 1 5/16	..	3 14 5
Do. 5 % 1st. Deb.	100	5	5	98 —100 xd	..	5 2 2
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅝ xd	..	5 0 0
Do. 4½ % 1st Deb.	100	4½	4½	97 — 99 xd	..	4 10 11
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	102 —104	..	4 16 2
Do. 5 % Mort. Bonds	100	5	5	96½ — 98½	..	5 1
Sao Paulo Tram, Lt. and P. 5 % 1st Deb.	$500	5	5	102 —104	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	83 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 1
Un. Elec. Trams Monte Video	5	7	6†	5⅛ — 6	..	5 16 8
Do. 6 % Pref.	5	6	6	4⅞ — 5⅜	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	1/16 — 3/16	..	8 0 0
Do. 6 % Pref.	1	6	6	2 1/16 — 2 3/16	..	7 13 11
Babcock & Wilcox	1	28	14†	3 13/16 — 3 15/16	+1/16	4 4 9
Do. Pref.	1	6	6	1 3/16 — 1 5/16	..	4 0 0
British Aluminium, Ord.	1	Nil	..	3/16 — 5/16	..	..
Do. 6 % Cum. Pref.	1	Nil	..	1 1/16 — 1 1/8	..	..
Do. 5 % Prior Lien Debs.	100	5	5	91 — 94	..	5 6 5
Do. Deb. Stk.	100	5	5	86 — 89	..	5 12 4
B.I. & Helsby Cables	5	10	8†	7⅞ — 8	..	6 5 0
Do. Pref.	5	6	6	5 7/16 — 6⅝	..	4 14 1
Do. Deb.	100	4½	4½	102 —104 xd	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 96	..	4 13 9
British Westinghouse, Pref.	8	Nil	Nil	1/16 — 3/16	..	Nil
Do. Deb.	100	4	4	58 — 61 xd	..	6 11 2
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	1	..	..	3/16 — 5/16	..	Nil
Do. Pref.	1	..	..	4/16 — 5/16	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — ½	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	73 — 78 xd	..	6 8 2
Do. 4½ % Deb.	100	4½	4½	47 — 52	..	8 13 2
Do. 4½ % Second Deb.	100	4½	4½	28 — 32 xd	..	14 1 4
Callender's Cable	5	15	10†	10¾ — 11¼	..	6 13 4
Do. Pref.	5	5	5	4⅛ — 5 xd	..	5 0 8
Do. Deb.	100	4½	4½	97 —100 xd	..	4 10 0
Castner-Kellner	1	20	20	30 — 32	..	5 6 8
Do. Deb.	100	4½	4½	106 —109	..	4 2 7

Crompton & Co.	8	Nil	..	1/16 — 3/16	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	Nil	3/16 — 5/16	..	..
Do. Pref.	1	6	6	1 — 1 1/16	..	6 17 2
Do. Deb.	100	4½	4½	95 — 98 xd	..	4 11 10
Edison & Swan, A, £8 paid	5	Nil	..	3/16 — 5/16	..	Nil
Do. fully paid	5	Nil	..	1 — 1 1/16	..	Nil
Do. 4 % Deb.	100	4	4	64 — 68 xd	..	5 17 8
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 13 4
Electric Construction	2	2½	2½	1 3/16 — 1 5/16	..	7 1 4
Do. Pref.	2	2	2	1 3/16 — 1 5/16	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7⅝ — 8	..	8 6 8
Do. Deb.	100	5	5	99 — 94	..	5 4 2
General Electric, Pref.	10	5	5	9⅝ — 10⅜ xd	..	..
Do. Deb.	100	4	4	90 — 95	..	4 4 3
Henley's, Ord.	5	17	5†	12½ — 13	..	6 10 9
Do. Pref.	5	4½	4½	4⅞ — 5 1/16	..	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	10	..	7½	9½ — 10½ xd	..	7 2 10
Do. Pref.	10	5	5	9½ — 10½ xd	..	4 17 7
Telegraph Construction	12	17½	5†	34½ — 36½	..	5 13 0
Do. Deb.	100	4	4	97½ —100½	..	3 19 6
Willans & Robinson	1	Nil	..	1/16 — 3/16	..	Nil
Do. Pref.	5	Nil	..	1/16 — 3/16	..	Nil
Do. Deb.	100	4	4	87 — 89	..	5 15 7

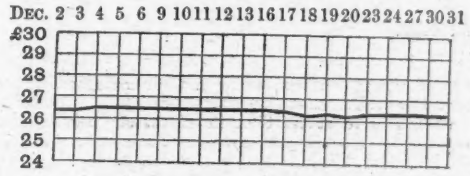
* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 5 per cent., October 17th, 1912.

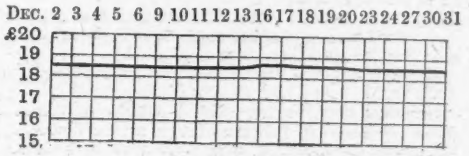
METAL MARKET.

Fluctuations in December.

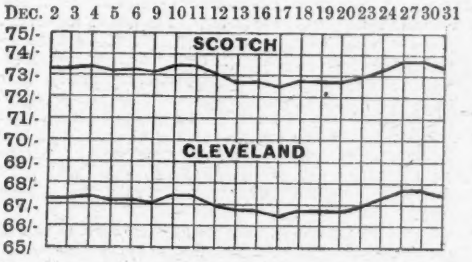
SPELTER (G.O.B's.).



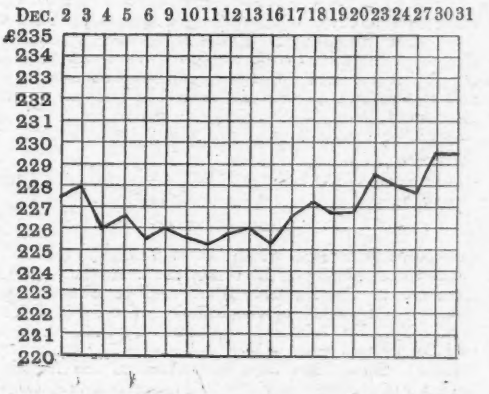
LEAD (ENGLISH).



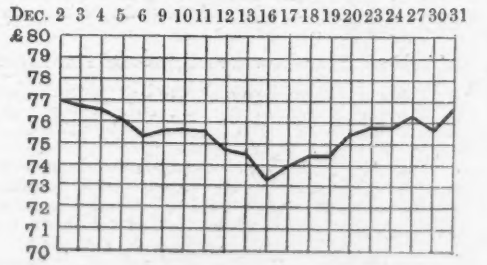
IRON.



TIN.



COPPER (G.M.B's.).



Belfast Electricity Supply.—At a meeting of the Tramways and Electrical Committee, a motion was moved and seconded for the rescinding of the report of Mr. S. L. Pearce and the electrical engineer on the proposed extension of the electrical undertaking, and was defeated by 8 to 2. It was stated that the extension scheme would be laid before the Finance Committee at an early date. It was reported by Messrs. Dick, Kerr & Co. that they had completed the route on five more roads under their permanent tramway contract. Mr. Nance reported that the Glengormely route had been doubled.

THE PROTECTION AND PRESERVATION OF STANDING TELEGRAPH AND TELEPHONE POLES.*

Practically all poles fail at the ground line because of decay, and on account of this weakening at the base, have to be replaced or cut off and reset, while the top portion is still sound.

In what is known as the "Lamb" pole treatment, the decay which has already started is rendered innocuous, and the ground line portion of the pole is then sealed with an impervious preservative coating, which prevents the evaporation of the preservative previously applied and prevents further decay by entirely excluding air and moisture.

The whole process is simple and inexpensive, and consists of first removing the soil around the base of the pole to a depth of 2 to 2½ ft. and scraping or cutting off the decayed portions of the wood. A hot brush treatment of coal-tar creosote is then applied liberally, which kills the living organisms of decay and penetrates the outer tissues of the wood. A fire-proof casing is then placed around the pole, the upper portion extending about 6 in. above the ground line and the lower portion from 18 in. to 2 ft. below, making a total length of from 2 to 2½ ft. This casing is held out from the pole by spacing rods, which leave about ½ in. opening between the pole and the casing at the solid portions, and a greater space where decay has occurred.

After the casing is in place, the soil is tamped in at the bottom up to the base of the casing, and inside of the form is poured a hot preparation of pitch which will yield a distillate of high-boiling and high-gravity creosote oil. The pitch, after it hardens, will form a perfect bond with the creosoted surface of the wood and entirely prevent the entrance of air, moisture, or other agencies favourable to decay, and at the same time prevent the evaporation of the creosote which was applied by brush treatment to the decayed surface. The creosote in the pitch acts as an additional toxic agent in destroying and preventing all forms of decay. Experiments have shown that this pitch filler will not only form a perfect bond with the wood and remain in absolutely close contact in all climatic changes, but it also entirely fills all surface cracks, and, to a slight degree, penetrates the wood. After the pitch has been poured in and has cooled, the soil is thrown back around the pole and tamped tight, and a protective fireproof covering or a cap of cement is applied; or, if the filler is poured to within only about 2 in. of the top, the edges of the fireproof casing can be bent over and tacked to the pole, thus obviating the use of a cement cap.

Under average conditions, one year's increase in the life of a pole will pay for the treatment. The average pole (cedar) has a life of about 10 years, and the cost of replacement is averaged at $10; hence the annual charge on a 4 per cent. compound interest basis amounts to about $1.25 per pole. If properly treated at the ground line, a conservative estimate places the increase in life at from 5 to 10 years.

Electric Light Advertising.—A striking means of advertising the existence of an electric power house in a locality and its ability to supply energy to all who require it has been adopted by the Consolidated Gas, Electric Light and Power Co., of Baltimore. This company uses a 24-in. marine type searchlight manufactured by the General Electric Co., mounted on the top of an abandoned smoke stack about 200 ft. from the ground. The projector is motor-driven for revolving in a horizontal plane and also has a motor for operating in a vertical plane. It has been used for about a year for advertising purposes, the lamp revolving continuously in one direction at a fixed elevation, and the searchlight being switched on each night after dark. The structure on the top of which the searchlight is mounted is a square brick erection, on three faces of which there are large electric signs. The idea in placing the searchlight on the stack was to call attention to the signs, causing public question as to the source of light, which could be seen in favourable weather 18 to 20 miles from Baltimore, and so to speak show the public "how far the light will go." During the Democratic Convention which was held at Baltimore recently, the searchlight was removed to the top of one of the largest structures in Baltimore, and used very effectively in connection with the scheme of special decoration adopted by the city during that period. Some experimental work has been done with coloured screens, using sheets of coloured gelatine framed and placed in front of the projector, but owing to the lack of penetration of coloured light the scheme met with only fair success. In the projection of colours, however, it was found that a white centre with a coloured rim of light was very effective. The idea, for particulars of which we are indebted to Mr. E. D. Edmonton, the general superintendent of the company, may be usefully adopted in this country in connection with gala displays in which electricity participates.

Manufacture of Potash.—A Swedish engineer named Lindblad has solved the problem of making potash from felspar, by melting potash felspar together with coal and iron in an electric furnace. There are great quantities of potash felspar in Sweden's rocks.—*Daily Telegraph.*

* E. A. Sterling, in the Canadian *Electrical News.*

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 31st.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	Nil	3/16 — 1/4 xd	..	Nil
Do. 5 % Pref.	1	5	5	7/16 — 1/2 xd	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	76 — 81	..	5 11 1
Brit. Elec. Trac., 6 % Pref.	100	..	..	11½ — 13½	..	..
Do. Do. Deferred	100	..	..	5 — 7	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	87 — 90	..	6 13 4
Do. 7 % Non-Cum. Pr'f.	100	..	..	39 — 42	..	..
Do. 5 % Perp. Deb.	100	5	5	92 — 96	..	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	77 — 81	..	5 7 2
Central London Railway, Ord.	100	8	8†	82 — 84	+1	3 11 5
Do. Pref.	100	4	4	83 — 85	..	4 14 2
Do. Def.	100	2	..	82 — 84	+2	2 7 7
Do. 4 % Deb.	100	4	4	98 —100 xd	..	4 0 0
City & South London, Ord.	100	1⅝	1½†	36 — 37	+1	3 14 4
Do. 5 % Pref., 1891	100	5	5	109 —111	..	4 10 1
Do. Do. 1896	100	5	5	109 —111	..	4 10 1
Do. Do. 1901	100	5	5	109 —111	..	4 10 1
Do. Do. 1908	100	5	5	109 —111	..	4 10 1
Do. 4 % Deb.	100	4	4	98 —100	..	4 0 0
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	2⅛ — 2⅜	..	Nil
Hastings Trams, 6 % Pref.	1	6	6†	5/8 — 3/4	..	8 6 8
Do. 4½ % Deb.	100	4½	4½	69 — 74	..	6 1 7
Isle of Thanet Trams, 5 % Pref.	5	2½	2½	2⅛ — 2⅜	..	4 15 3
Do. 4 % Deb.	100	4	4	75 — 96 xd	..	5 0 0
Lancashire United, 5 % Deb.	100	5	5	78 — 80 xd	..	6 5 0
London Elec. Railw'ys, 4 % Deb.	100	4	4	94 — 96 xd	..	4 3 4
London United Trams, 5 % Pref.	10	Nil	..	5 — 6	..	..
Do. 4 % Deb.	100	4	4	69 — 72 xd	−1	5 11 1

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 31st.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	* 100	1½	1½†	58 — 58½	+1/2	3 0 9
Do. Surplus Lands	100	2¼	2½†	62 — 64	..	4 6 0
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	85 — 87	..	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	40½ — 41	+ 1/2	Nil
Do. 6 % Deb.	100	6	6	139 —141 xd	+1	4 4 0
Do. 4 % Deb.	100	4	4	93 — 95 xd	..	4 2 6
Do. 4 % Prior Lien	100	4	4	99 —101	..	3 19 3
Do. 4½ % First Pref.	100	4½	4½	88 — 90	..	5 0 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	6	5†	1 1/16 — 1 1/8	..	5 1 1
Do. Def.	1	Nil	..	1/4 — 1/8	..	Nil
Do. 5 % Pref.	1	5	5	3/8 — 7/16	..	5 14 3
Do. 4½ % Deb.	100	4½	4½	91 — 93 xd	..	4 14 9
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Potteries, Ord.	1	5/8	..	7/16 — 1/2	..	..
Do. 5 % Pref.	1	5	5	13/16 — 7/8	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	85 — 89	..	5 2 8
South Metro. Trams, 6 % Pref.	1	6	..	11/16 — 3/4	..	7 7 8
Do. 4 % Deb.	100	4	4	65 — 70 xd	..	5 14 4
Underground Elec. Railways	10	..	..	4 7/8 — 4 15/16	..	Nil
Do. "A"	1/-	..	..	7/8 — 1 1/16	..	..
Do. 6% First Cum. Inc. Deb.	100	..	6	111 —113	..	5 6 2
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	£100	1½	£2	92½ — 93½	+ 1/2	..
Yorkshire (West Riding), Ord.	5	Nil	..	3/4 — 7/8	..	Nil
Do. 6 % Pref.	5	3	3†	8 — 8½ xd	..	4 5 9
Do. 4½ % Deb.	100	4½	4½	77 — 81 xd	..	5 8 5

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4 3/8 — 5 xd	..	5 10 0
Do. 2nd Pref.	5	5½	5½	4 1/16 — 4 1/8 xd	..	5 14 3
Do. 4 % Deb.	100	4	4	92 — 94 xd	..	4 5 1
Do. 4½ % Deb.	100	4½	4½	97 — 99 xd	..	4 10 11
Do. 5 % Deb.	100	5	5	98 — 100	+ 1/2	5 0 0
Auckland Trams, 5 % Deb.	100	5	5	101 —103 xd	..	4 17 1
Bombay Elec. S. & Trams, Pref.	10	6	6	11⅛ — 12¼	..	4 18 0
Do. 4½ % Deb.	100	4½	4½	96 — 98 xd	..	4 11 10
Do. 5 % 2nd Deb.	100	5	5	99 —101	..	4 19 0
Brazilian Traction Light and Power	$100	..	..	93⅛ — 95⅛	+ 2½	..
Brisbane Trams Invt., Ord.	5	8	8†	7 1/16 — 7 5/16	..	5 9 5
Do. 5 % Pref.	5	5	5	4 7/16 — 4 5/8	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	99 —102 xd	..	4 8 3
B. Columbia Elec. Rly., Def.	100	8	..	139 —144	..	5 11 2
Do. Pref. Ord.	100	6	6	118 —122	+1	4 18 4
Do. 5 % Pref.	100	5	5	107 —110	+ 1/2	4 10 11
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98⅛ —101½	..	4 8 8
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	97 —100	..	4 5 0
Calcutta Trams, Ord.	5	7	5†	5⅝ — 6⅛	..	5 14 3
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16 xd	..	4 17 7
Do. 4½ % Deb.	100	4½	4½	97 —100	−2	4 10 0
Cape Electric Trams	1	2½	..	3/4 — 7/8	..	..
City Buenos Aires Trams (1904)	5	5	5†	5 1/16 — 5 1/8	..	4 8 0
Do. 4 % Deb.	100	5	5	97 —100 xd	..	5 0 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 97	..	5 3 1
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	3/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	88 — 88 xd	..	5 13 8
Do. 6 % B Deb.	100	6	8	30 — 40	..	..
La Plata Elec. Trms, Ord.	1	Nil	..	3/16 — 3/8	..	..
Do. Pref.	1	6	..	5/8 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1 — 1⅛	..	4 16 0
Do. 6 % Pref.	1	6	6	1 — 1 1/4 xd	..	4 16 0
Do. 5 % Deb.	100	5	5	93 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	98 —100 xd	..	5 0 0
Manaos Trams & Lt., 1st Deb.	100	5	5	89 — 92	..	5 8 8
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½ —102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	111 —113	+2	6 3 11
Do. Gen. Con. 5 % Bonds	..	5	5	96 — 98	+ 1/2	5 2 0
Do. 6 % Bonds	100	6	6	103 —105	+1½	5 14 3
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7½ — 7⅝	+ 1/8	6 9 0
Do. 6 % Pref.	5	6	6	5 — 5⅛	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	97½ — 99½	+ 1/2	5 0 6
Perth (W.A.) Elec. Tr., Ord.	1	5	5½	1 3/32 — 1 1/16	..	3 14 5
Do. 5 % 1st. Deb.	100	5	5	98 —100 xd	..	5 2 2
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 7/8 — 6 xd	..	5 0 0
Do. 4½ % 1st Deb.	100	4½	4½	97 — 99 xd	..	4 10 11
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	102 —104	..	4 16 2
Do. 5 % Mort. Bonds	100	5	5	96½ — 98½	..	5 1
Sao Paulo Tram, Lt. and P. 5 % 1st Deb.	$500	5	5	102 —104	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 1
Un. Elec. Trams Monte Video	5	7	6†	5½ — 6	..	5 16 8
Do. 6 % Pref.	5	6	6	4 7/8 — 5 1/8	..	5 11 7
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	1/8 — 3/16	..	8 0 0
Do. 6 % Pref.	1	6	6	3/4 — 13/16	..	7 13 11
Babcock & Wilcox	1	28	14†	8 1/16 — 8 1/8	+1/8	4 4 9
Do. Pref.	1	6	6	1 3/16 — 1 1/4	..	4 0 0
British Aluminium, Ord.	1	Nil	..	5/8 — 3/4	..	..
Do. 6 % Cum. Pref.	1	Nil	..	1 1/16 — 1 1/8	..	..
Do. 5 % Prior Lien Debs.	100	5	5	91 — 94	..	5 6 5
Do. Deb. Stk.	100	5	5	86 — 89	..	5 12 4
B.I. & Helsby Cables	5	10	8†	7 1/8 — 8	..	6 5 0
Do. Pref.	5	6	6	5 7/8 — 6 1/8	..	4 14 1
Do. Deb.	100	4½	4½	102 —104 xd	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	94 — 96	..	4 13 9
British Westinghouse, Pref.	8	Nil	Nil	3/4 — 7/8	..	Nil
Do. Deb.	100	4	4	58 — 61 xd	..	6 11 2
Do. 6 % Prior Lien	100	6	6	100 —108	..	5 16 6
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — 1/2	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	73 — 78 xd	..	6 8 2
Do. 4½ % Deb.	100	4½	4½	47 — 52	..	8 13 2
Do. 4½ % Second Deb.	100	4½	4½	28 — 32 xd	..	14 1 4
Callender's Cable	5	15	10†	10¼ — 11½	..	6 13 4
Do. Pref.	5	5	5	4 3/8 — 5 xd	..	5 0 0
Do. Deb.	100	4½	4½	97 —100 xd	..	4 10 0
Castner-Kellner	1	20	20	33 — 35	..	5 6 8
Do. Deb.	100	4½	4½	106 —109	..	4 2 7
Crompton & Co.	8	Nil	..	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	Nil	1 1/16 — 1 1/8	..	..
Do. Pref.	1	6	6	1 1/16 — 1 1/8	..	6 17 2
Do. Deb.	100	4½	4½	95 — 98 xd	..	4 11 10
Edison & Swan, A, £8 paid	5	Nil	..	1/8 — 3/8	..	Nil
Do. fully paid	5	Nil	..	1 — 1 1/4	..	Nil
Do. 4 % Deb.	100	4	4	64 — 68 xd	..	5 17 8
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 13 4
Electric Construction	3	2½	3⅛	1 1/16 — 1 1/8	..	7 1 4
Do. Pref.	3	7	7	2 — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7 — 8	..	8 5 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	93 — 102 xd	..	..
Do. Deb.	100	4	4	90 — 95	..	4 4 8
Henley's, Ord.	5	17	5†	12½ — 13	..	6 10 9
Do. Pref.	5	4½	4½	4 1/16 — 5 1/16	..	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	10	..	7½	9½ — 10½ xd	..	7 2 10
Do. Pref.	10	6	5	9½ — 10½ xd	..	4 17 7
Telegraph Construction	12	17½	5†	84½ — 86½	..	5 13 0
Do. Deb.	100	4	4	97½ —100½	..	3 19 6
Willans & Robinson	1	Nil	..	1/16 — 1/8	..	Nil
Do. Pref.	*5	Nil	..	1/2 — 3/4	..	Nil
Do. Deb.	100	4	4	57 — 59	..	6 15 7

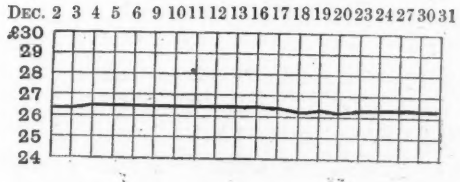
* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 5 per cent., October 17th, 1912.

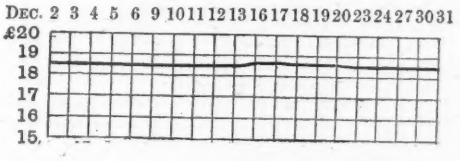
METAL MARKET.

Fluctuations in December.

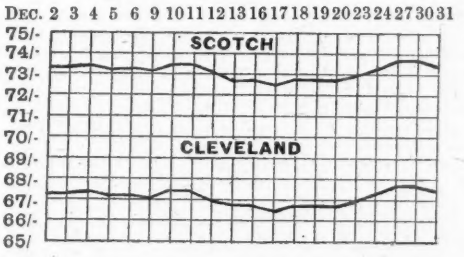
SPELTER (G.O.B's.).



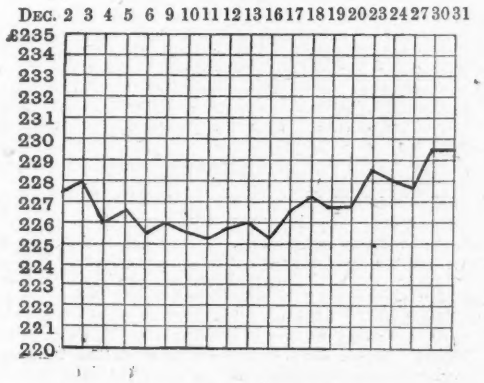
LEAD (ENGLISH).



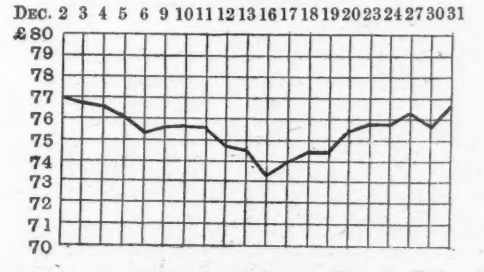
IRON.



TIN.



COPPER (G.M.B's.).



Belfast Electricity Supply.—At a meeting of the Tramways and Electrical Committee, a motion was moved and seconded for the rescinding of the report of Mr. S. L. Pearce and the electrical engineer on the proposed extension of the electrical undertaking, and was defeated by 8 to 2. It was stated that the extension scheme would be laid before the Finance Committee at an early date. It was reported by Messrs. Dick, Kerr & Co. that they had completed the route on five more roads under their permanent tramway contract. Mr. Nance reported that the Glengormely route had been doubled.

THE PROTECTION AND PRESERVATION OF STANDING TELEGRAPH AND TELEPHONE POLES.*

PRACTICALLY all poles fail at the ground line because of decay, and on account of this weakening at the base, have to be replaced or cut off and reset, while the top portion is still sound.

In what is known as the "Lamb" pole treatment, the decay which has already started is rendered innocuous, and the ground line portion of the pole is then sealed with an impervious preservative coating, which prevents the evaporation of the preservative previously applied and prevents further decay by entirely excluding air and moisture.

The whole process is simple and inexpensive, and consists of first removing the soil around the base of the pole to a depth of 2 to 2½ ft. and scraping or cutting off the decayed portions of the wood. A hot brush treatment of coal-tar creosote is then applied liberally, which kills the living organisms of decay and penetrates the outer tissues of the wood. A fire-proof casing is then placed around the pole, the upper portion extending about 6 in. above the ground line and the lower portion from 18 in. to 2 ft. below, making a total length of from 2 to 2½ ft. This casing is held out from the pole by spacing rods, which leave about ½ in. opening between the pole and the casing at the solid portions, and a greater space where decay has occurred.

After the casing is in place, the soil is tamped in at the bottom up to the base of the casing, and inside of the form is poured a hot preparation of pitch which will yield a distillate of high-boiling and high-gravity creosote oil. The pitch, after it hardens, will form a perfect bond with the creosoted surface of the wood and entirely prevent the entrance of air, moisture, or other agencies favourable to decay, and at the same time prevent the evaporation of the creosote which was applied by brush treatment to the decayed surface. The creosote in the pitch acts as an additional toxic agent in destroying and preventing all forms of decay. Experiments have shown that this pitch filler will not only form a perfect bond with the wood and remain in absolutely close contact in all climatic changes, but it also entirely fills all surface cracks, and, to a slight degree, penetrates the wood. After the pitch has been poured in and has cooled, the soil is thrown back around the pole and tamped tight, and a protective fireproof covering or a cap of cement is applied; or, if the filler is poured to within only about 2 in. of the top, the edges of the fireproof casing can be bent over and tacked to the pole, thus obviating the use of a cement cap.

Under average conditions, one year's increase in the life of a pole will pay for the treatment. The average pole (cedar) has a life of about 10 years, and the cost of replacement is averaged at $10; hence the annual charge on a 4 per cent. compound interest basis amounts to about $1.25 per pole. If properly treated at the ground line, a conservative estimate places the increase in life at from 5 to 10 years.

Electric Light Advertising.—A striking means of advertising the existence of an electric power house in a locality and its ability to supply energy to all who require it has been adopted by the Consolidated Gas, Electric Light and Power Co., of Baltimore. This company uses a 24-in. marine type searchlight manufactured by the General Electric Co., mounted on the top of an abandoned smoke stack about 200 ft. from the ground. The projector is motor-driven for revolving in a horizontal plane and also has a motor for operating in a vertical plane. It has been used for about a year for advertising purposes, the lamp revolving continuously in one direction at a fixed elevation, and the searchlight being switched on each night after dark. The structure on the top of which the searchlight is mounted is a square brick erection, on three faces of which there are large electric signs. The idea in placing the searchlight on the stack was to call attention to the signs, causing public question as to the source of light, which could be seen in favourable weather 18 to 20 miles from Baltimore, and so to speak show the public "how far the light will go." During the Democratic Convention which was held at Baltimore recently, the searchlight was removed to the top of one of the largest structures in Baltimore, and used very effectively in connection with the scheme of special decoration adopted by the city during that period. Some experimental work has been done with coloured screens, using sheets of coloured gelatine framed and placed in front of the projector, but owing to the lack of penetration of coloured light the scheme met with only fair success. In the projection of colours, however, it was found that a white centre with a coloured rim of light was very effective. The idea, for particulars of which we are indebted to Mr. E. D. Edmonton, the general superintendent of the company, may be usefully adopted in this country in connection with gala displays in which electricity participates.

Manufacture of Potash.—A Swedish engineer named Lindblad has solved the problem of making potash from felspar, by melting potash felspar together with coal and iron in an electric furnace. There are great quantities of potash felspar in Sweden's rocks.—*Daily Telegraph.*

* E. A. Sterling, in the Canadian *Electrical News.*

REPORT TO THE BOARD OF TRADE ON THE UNDERWRITERS' LABORATORIES (INC.), CHICAGO.

Its Formation, and Scope of Operations, with their Effect on the Importation of British Manufactures into the Dominion of Canada.

BY C. HAMILTON WICKES.

THE UNDERWRITERS' LABORATORIES, CHICAGO, INCORPORATED.

THE U.L.C. is located in a specially-designed building at 207, East Ohio Street, Chicago, Ill., with a plant and equipment valued at £20,000. It was granted a charter in November, 1901. The U.L.C. has one Branch Testing Laboratory (recently erected) at New York.

The establishment of the Underwriters' Laboratories, Chicago, was brought about doubtless by the great and disproportionate destruction of property by fire throughout the United States, and in consequence of the heavy losses that resulted, which fell on the insurance companies (fire underwriters).

It should be understood that the problem the insurance companies had to solve, in view of the conditions prevailing throughout the United States, and it may be said North America, was to evolve some method which would tend to reduce the great danger existing of fire hazard and the consequent restriction of business. Among other difficulties appertaining to the position differing from the United Kingdom was:—(*a*) The common use of wooden buildings; (*b*) the great area of the territory; (*c*) the high voltage of the electric current transmitted by overhead wires, even through the main streets of their cities; (*d*) the large number of manufacturers, good, indifferent and bad, intent only on selling their products, in many instances to firms with little or no technical knowledge, who styled themselves contractors, architects, &c.; (*e*) the compelled employment of careless, indifferent and incompetent workmen; (*f*) together with the practical impossibility of obtaining anything like skilled inspection or supervision of the work, even in the towns.

To use the phraseology of "The National Board of Fire Underwriters (New York)," "it was found necessary to provide means for securing a correct solution of the problems presented by reason of the great and disproportionate losses by fire, and to bring to the 'user' the one best obtainable opinion on the merits or demerits of appliances in respect of fire hazard."

This is a high and proper ideal, but however great the necessity might have been for an institution of this character, that would not in itself necessarily have brought about the inception, nor given the U.L., Chicago, the power, and, practically, the absolute control, it exercises to-day over all articles, appliances, material or devices styled "articles for public utility" affecting fire hazard used in buildings throughout the country. It is due to the hearty support which came to be accorded as the value of the Laboratories' work became recognised by the insurance companies—British, American, German, French and Canadian—carrying on business in the North American Continent.

The Laboratories had quite a humble beginning, and I am informed that at the first they confined their attention to certain classes of electric material and fittings, *e.g.*, the "National Electric Code" standards were first compiled in 1896-7 (see later), but their influence has steadily grown and they cover to-day (*inter alia*):—

(*a*) Machines and fittings which may be instrumental in carrying a fire, gas and oil appliances, electric fittings, wiring, conduits, fuses, &c. Machines and appurtenances used in lighting or heating chemicals.

(*b*) Fire extinguishers, automatic sprinklers, pumps, hand fire appliances, hose, hydrants, nozzles, valves, &c.

(*c*) Material and devices designed to retard spread of fire, structural methods and materials, fire doors and shutters, fire windows, &c.

President of the Corporation, chairman of the Board, Mr. Henry C. Eddy, of Chicago (resident secretary, Commercial Union Assurance Co., and the Palatine Insurance Co.); secretary and treasurer. Mr. Wm. H. Merrill, Chicago. The board of directors consists of 10 other gentlemen, of whom four represent British companies, and six American insurance companies. (Particulars, see Appendix A.)*

There are, therefore, including the two British insurance companies represented by the president, six British and six American companies represented on the Board of the U.L.C.

The board constitutes the governing authority, handles its finances, and directs all matters of policy, including appointment of "the Council," the manager and members of the engineering staff.

TECHNICAL STAFF OF UNDERWRITERS' LABORATORIES (INC.), CHICAGO.

The manager is Mr. W. H. Merrill; the chief engineer, Mr. W. C. Robinson (who recently visited England), and there is a staff of over 50, which includes consulting, electrical, gas and oil, and chemical engineers, with numerous assistant engineers, a superintendent of labels, cashier, &c. (Names, see Appendix B.)

THE COUNCIL.

A body having important functions connected with the U.L.C. is "the Council." The members are nominated by the "board of directors of the laboratories," as stated above. "The Council" consists of gentlemen who, either in their individual or corporate capacity, have the requisite knowledge or employ technical men on their staff, able to advise them in respect of "the Reports" forwarded for their consideration by the Underwriters' Laboratories. It will be noted that among the members of the Council are Mr. W. H. Merrill, manager of the Laboratories, Mr. W. C. Robinson, his chief engineer, and Mr. Hadrill, who, as secretary to the Canadian Fire Underwriters' Association, has under him quite a number of technical men.

It is by "the Council" that the technical work at the Laboratories is supervised, and it is not until "the Reports" are approved by "the Council" that they are promulgated.

The Council numbers 22 (names and such particulars as are obtainable will be found in Appendix C).

The technical staff, having carried out the experimental work and tested the merits or demerits of each article, device, appliance, material or system submitted, with a view to their bearing upon fire hazard, proceed to draw up a detailed and extremely elaborate "report." This report is forwarded to each member of the Council, and in due course is returned to the Laboratories with such endorsements, amendments or criticism as each member of the Council may consider necessary or advisable. The points raised, if any, are then printed and again circulated to all the members until a "decision" has been obtained. The final decision, whether favourable or otherwise to the article, device, appliance, material or system, is bulletined, *i.e.*, a summary of the Laboratories' Report is distributed on "printed cards," filed according to classification, to the various insurance organisations and companies subscribing to or co-operating with the Laboratories' work. A copy of the bulletin (printed card, presumably) and the detailed report is furnished to the applicant, who originally submitted the article for inspection.

There can be no doubt that the greatest care is taken in the experimental work and tests carried out by the Laboratories, and equal care in the preparation of the Report in its final shape before any article, appliance, material, device or system receives the final approval of the U.L.C.

It may be observed here that cabinets containing these cards are maintained at the offices of the principal Boards of Underwriters and inspection bureaus in the United States and Canada and a few in other countries, at many of the general offices of insurance companies, certain municipal departments, and at the local offices of the Laboratories in the larger cities. There are also "lists" compiled by the Laboratories, which are freely distributed, of "approved and permitted devices," with the manufacturer's name. (See Appendix D.)

SPECIFICATIONS, RULES AND REQUIREMENTS UNDER WHICH THE EXPERIMENTAL WORK IS CARRIED ON AT THE LABORATORIES.

The specifications under which the experimental work is carried on by the technical staff of the U.L.C. are based upon the rules and requirements of the National Board of Fire Underwriters, New York, as "recommended by the National Fire Protection Association, New York." This is the present practice; previously the various Committees acted solely under the direction of insurance authorities. These have been transferred to the National Fire Protection Associations, in which "all interests are represented."

Many of "The Rules and Requirements" referred to above are printed in pamphlet form. A list is appended herewith (marked "Appendix E"). Printed copies of these pamphlets are filed with the Board of Trade.

INSPECTION AT MANUFACTURERS' FACTORIES AND LABELLING.

The article, appliance, device, material or system submitted to the U.L.C. having been tested and approved, the Laboratories step in and say, "Before the article may be 'marketed' it must come under our supervision before we will issue 'a label or tab' to indicate that the same has been inspected and passed by us."

The older form of supervision is: A contract to be entered into between the manufacturer and the U.L.C. whereby the maker agrees to construct appliances in exact duplicate of the sample approved, and to pay a certain fee annually, ranging from $5 to $30.

The second or newer form of supervision consists in inspection by Laboratory engineers of the devices and materials at factories, and the labelling of standard goods by stamps, transfers, or metal labels, whereby they can be recognised wherever found. The cost of the service is partially defrayed by charges made for the labels. These vary according to the nature and extent of the inspection needed.

A "schedule" of the charges for labelling certain "standard goods" will be found, as a guide, in Appendix "F," together with specimen lithographed labels. The sale of these labels includes the following costs:—

1. Cost of manufacturing the label.
2. Salaries and expenses of agents and inspectors of branch offices.
3. Salary of supervising engineer at home office.
4. Salary and travelling expenses of special agent.
5. Overhead charges.

* The various Appendices, &c., mentioned are not reprinted here. They may be seen at the Board of Trade Commercial Intelligence Department, in London.

INSPECTION.

Throughout the United States the U.L.C. has officers who inspect and pass articles, appliances, devices, material or the system installed in any building which the owner requires to insure. It is these inspectors who accept or refuse articles because they have not the U.L.C. label or tab. So far as the Dominion of Canada is concerned, the inspectors are appointed by the Canadian Fire Underwriters' Association (concerning whom, see later). The contention is that the inspection departments of insurance organisations find it easier to pass upon an installation in which nothing but labelled material is used—and this it is contended tends to a better class of installation.

It should not be inferred that the inspector's duty is confined to checking the labelled material. It is important from the manufacturer's point of view, but from the insurance companies' standpoint, the inspector has to see that the workmanship of the wireman and electrician, for example, is good, and that the work has been carried out in accordance with the Rules and Regulations dealing with the design and layout of the installation. Generally, his skill in judgment and experience is called for in interpreting these rules and requirements in accordance with the particular kind of building which he is inspecting for the time being.

An important factor is the question of danger to life "should a fire occur." This, I fear, is not taken into account, in fact, I understand it cannot come within the inspector's consideration, so long as the installation complies with safeguarding fire hazard.

COST OF EXPERIMENTS AND TESTS, WITH SOME PARTICULARS TO INTENDING APPLICANTS.

Blank forms for use in making applications for tests will be furnished on request to the U.L.C., 207, East Ohio Street, Chicago, although no fixed form of application is necessary. A letter addressed to the Laboratories, setting forth all the claims made for the article, "enclosing the preliminary fee," and giving notice of shipment, is sufficient. All shipments should be consigned to Underwriters' Laboratories (Inc.), 207, East Ohio Street, Chicago. The latter are not responsible for damage in shipment, and cannot undertake to repair damaged goods, or to assemble or erect apparatus shipped in parts.

Freight or express charges must be prepaid.

Goods from the United Kingdom should be shipped in bond.

It is understood that Customs charges, if any, are paid by the Laboratories.

It will be noted in the particulars given below that in respect of articles coming within Groups A to E, there is "a maximum" cost, which will not, under any circumstances, be exceeded.

The Laboratories will, on receipt of an application accompanied by description of the article to be tested, advise as to necessary charges in each case, and in all instances where the costs do not aggregate the amount of the preliminary fees, the balance will be returned to the applicant, to whom, at the conclusion of the "test," a full and detailed account is rendered, and, as stated above, a copy supplied of "the Bulletin," as well as the "detailed Report." The fees are as follows:—

Group A.	Preliminary	fee,	$100.00	Total cost not to exceed			$250
" B.	"	"	50.00	"	"	"	100
" C.	"	"	25.00	"	"	"	75
" D.	"	"	10.00	"	"	"	50
" E.	"	"	5.00	"	"	"	25

Group F.—Under this group are classified experimental work and researches covering subjects or appliances for which standard requirements are not accepted. The amount of preliminary fee is $100.00, and bills are rendered monthly as the work proceeds.

The various articles, appliances, materials, devices and systems thus far tested (1909), are classified into the various Groups A to E. (Particulars will be found in Appendix G.)

GENERAL REMARKS.

The parent body of the Underwriters' Laboratories, Chicago, is "the National Board of Fire Underwriters, New York," under whose "general direction" the work at the Laboratories is carried on. In practice, however, the power of the parent body may be said to be vested in "The Board of Directors." The chief financial support is derived from the parent body, the Laboratories not being in business for "profit"; it is not believed that it has made any profit; the U.L.C. is a corporation for fire protection and fire prevention and not for profit. The insurance companies are the largest contributors. They receive regular appropriations from the National Board of Fire Underwriters, the Western Insurance Union, and other organisations, as well as from a number of individual companies who desire special service in the matter of reports.

It will be noted in going through the Report that the Rules and Requirements are adopted by the N.B. of F.U. (N.Y.) under the recommendation of the "National Fire Protection Association, of New York" (secretary's office, 87, Milk Street, Boston). This important Association, whose President for the year 1912-13 is Mr. H. L. Phillips, of 5, Haynes Street, Hartford, Conn. (vice-President, Mr. G. M. Robertson, of San Francisco; and secretary-treasurer, Mr. F. H. Wentworth, 87, Milk Street, Boston; with a chairman and executive committee of 15 gentlemen, five of whom retire yearly) dates from the year 1896-7, about which time a "National Conference" was held at New York.

Standard electrical rules were drawn up as the result of the united efforts of the various insurance, electrical, architectural and allied interests; the National Conference was disbanded, the work (of the Underwriters' National Electrical Association and of the National Conference) being taken over by the National Fire Protection Association. The following Associations, formerly members of the National Conference, are represented on the Electrical Committee of the N.F.P.A.:—

American Electric Railway Association.
American Institute of Electrical Engineers.
Associated Factory Mutual Fire Insurance Co.
National Board of Fire Underwriters.
National Electric Light Association.
National Electrical Contractors' Association.
National Electrical Inspection Association.

The work of the National Fire Protection Association, of New York, is directed by "Special Committees," of which there are no less than 29, and covers subjects as wide apart as "safes and vaults" and "hose," "electric railway, light and power properties," "automatic sprinklers," "fire pumps," "gravity tanks," "mine fires," "laws and ordinances," "signalling systems," &c. A list of these Committees giving the names of their chairmen will be found in Appendix H.

The "report" of proceedings of the sixteenth annual meeting held at Chicago, May 14th, 15th and 16th, 1912, accompanies this "report," and "The Year-Book" of the National Fire Protection Association (September, 1912) gives the membership, from which further detailed particulars can be ascertained.

The membership of the N.F.P.A. consists of four classes: Active, who only have the power to vote—membership 102, with a subscription of $15 per annum; Associate, over 1,200 members, annual subscription $5; Subscribing, over 600 members, annual subscription $5; Honorary, 3 life members.

The Active class comprises 102 members, including (1) National Institutes, Societies and Associations interested in the protection of life and property against loss by fire, (2) State Associations, whose principal object is the reduction of fire waste, (3) Insurance Bodies and Insurance Associations having primary jurisdiction. Out of these 102 Active class members 82 are Insurance Companies (fire underwriters) or Associations connected therewith, such as inspection bureaus, actuarial bureaus, &c. Twenty may be styled business associations. Among the latter are the following:—

American Institute of Electrical Engineers, New York.
American Institute of Consulting Engineers, New York.
American Electric Railway Association, New York.
American Institute of Architects.
American Warehousemen's Association, Pittsburg.
Canadian Manufacturers' Association.
Electrical Supply Jobbers' Association, Chicago.
National Association of Manufacturers, New York.
National Hardware Association, Philadelphia.
National Paint, Oil and Varnish Association, New York.
National Electric Light Association, New York.
National Electrical Contractors' Association, Utica, New York.
National Association of Sheet Metal Contractors, Philadelphia.
Canadian Fire Underwriters' Association, Montreal and Toronto.
Mainland Fire Underwriters' Association, Vancouver, B.C.
New Brunswick Board of Fire Underwriters, St. John, N.B.
Nova Scotia Board of Underwriters, Halifax, N.S.
Western Canada Fire Underwriters' Association, Winnipeg.

CANADIAN FIRE UNDERWRITERS' ASSOCIATION. Offices, 535, Coristine Building, Montreal. Secretary, Mr. A. W. Hadrill.

At the present time 60 insurance companies are members of this Association. I might mention that while this is by far the most important of the Underwriters' Associations in the Dominion of Canada, there are four others, as stated above.

Of the present list of 60 members of the Canadian Fire Underwriters' Association (full list, Appendix I), 28 are British, or their capital is controlled in Great Britain, 19 are American, 12 Canadian, 1 French.

The British insurance companies—headed by the Royal Insurance Co.—together underwrite some 55 per cent. of the total fire risks in the Dominion of Canada, and therefore occupy an important position in the Associations of Fire Underwriters throughout Canada. Their position and influence in the United States of America are also considerable.

BRITISH MANUFACTURERS *v.* THE OPERATIONS OF THE UNDERWRITERS' LABORATORIES, CHICAGO.

The experimental work carried out by the Laboratories at Chicago, their method of drawing up reports and labelling approved articles, followed by inspection, already dealt with, is no doubt advantageous, not only to the fire insurance companies, but also to the American manufacturer carrying on business in the United States. I would also be prepared to concede that the U.L.C. are desirous of not placing difficulties in the way of the foreign manufacturer (which includes British) utilising the facilities offered by them. It is nevertheless an intolerable state of affairs that the British manufacturers, as well as the Canadian, should be compelled to send samples and particulars of their goods to a foreign corporation, to be "approved or rejected," before they are able or permitted to do business in a portion of the British Empire, viz., the Dominion of Canada.

I will briefly outline some of the more salient points which operate to the disadvantage of the British manufacturer desiring to do business in the Dominion:—

1. The British manufacturer has to incur the expense of packing and freighting the articles forwarded to the Laboratories at Chicago, with the consequent delay. Whether the article is approved or otherwise, he is still unable to ship the goods to the Dominion, as no means exist of examination and labelling at the

factory in the United Kingdom, which the Laboratories properly insist on.

The suggestion has been put forward that such goods shipped to Canada might be examined and labelled, as the Laboratories require, at "the port of discharge" in the Dominion. The objection to this course is that besides the expense of maintaining a qualified inspector, there is a real risk incurred of the goods not being passed (rightly or wrongly), with consequent loss to the British shipper, in all probability followed by the return of the goods to the United Kingdom, with the great expense thereby entailed.

2. The Laboratories are officered by consulting and other engineers expert in regard to various lines, as has been shown. It may be conceded that they exercise a wise and discriminating care in the carrying out of their duties in regard to American manufacturers, but when it comes to experimenting and testing articles of British or European manufacture, devised on different lines and manufactured to standards other than the rules, requirements or standards laid down by the N.F.P.A., under which the Laboratories carry out their work, the technical staff, without any experience in regard to the reliability of the article submitted in actual use, not infrequently find themselves obliged to withhold their authorisation. To this the British manufacturer very properly objects, and he feels the more indignant when he is aware that his manufactures in every way meet the more stringent requirements in other parts of the world. I think he should be supported in this objection unless, indeed, we are prepared to concede that the United States engineer is the repository of all the wisdom of the world in regard to every class of article, appliance, system or device dealing with fire hazard, which has been, or is to be, invented in the world. (See Mr. Merrill's letter, giving another reason.)

3. *System of Inspection.*—This amounts, in practice, to the inspectors appointed seeing that certain labels or tabs are appended to articles. In time, no doubt, they become more or less experienced, but the idea is to throw the responsibility of the real inspection of the article on the Laboratories at Chicago. The inspector is, apparently, expected to work on rule-of-thumb lines. He is, I gather, not expected to do otherwise than see that labels or tabs of the U.L.C. are properly attached to the article, device or system to be installed in the various buildings.

The tendency is for this attitude to become accentuated; pressure has been, and is being, exercised by the Laboratories on the Canadian Fire Underwriters' Association not to allow any article to be installed, within their jurisdiction, without the Laboratories' label or tab. In Winnipeg the use of the Laboratories' label has been made the rule by the Western Canadian Fire Underwriters' Association. In Montreal they have been, I am informed, not quite so strict up to the present, but Mr. Hadrill, secretary of the Canadian Fire Underwriters' Association, confesses that their inclination is to draw the line tighter and only permit goods with the label or tab of the U.L.C. to be utilised.

I might mention in this connection that complaints, difficult to prove or disprove, are made by British manufacturers or their representatives of prejudice on the part of inspectors against British goods, and of the necessity, as they allege, of gaining the inspector's goodwill by means of a *douceur* in order to facilitate the passing of material submitted. This difficulty is probably in respect of articles without the customary Laboratories' label or tab.

I would refer to what has been stated before, and that is, that the Inspectors' skill and judgment is called for in regard to the application of the Rules and Requirements, *e.g.*, the workmanship of the wireman or electrician generally regarding the design and lay-out of the installation, taking into consideration the particular kind of building in which the work is being carried out.

I would also repeat that I understand there are no regulations to guide the Inspector with reference to "danger to life" in the event of fire breaking out; in other words, that the wiring and other matters which he inspects are looked at purely and only from the point of view of fire hazard to the building, without regard to the matter of hazard against life (shock fatality, and so forth).

4. It will be readily recognised in view of the manufacturing and other Mercantile Associations which are "active" members of the N.F.P.A. and the American composition of the Council, and the experience practically based on American practice, so far as I know it, of the technical staff of the Laboratories, that the introduction of new methods or fresh standards might meet with considerable opposition, and, in addition, there would probably be a natural reluctance to give a definite finding in respect of articles which may be practically unknown either in respect of their form or in regard to their reliability.

5. It should be mentioned that particulars are filed in this office of instances in which the parties alleged discrimination and unfair treatment, in respect of both electrical and other classes of goods submitted to the Laboratories. Personally, I find it hard to believe that any discrimination has been shown beyond what may be easily explained by the composition of the Laboratories, the council and the associations under whose direction the work is carried on. An incident which happened in Montreal in August last illustrates another phase of the difficulty met with by British goods sent to Canada. A sample of wire was sent to the Chief Electrical Inspector in Montreal, and I have a copy of his letter in which he stated, "the samples of wires enclosed are acceptable." In Toronto the following month, in regard to the same article, I have a copy of the original letter from the Chief Electrical Inspector, in which he writes as follows:—"We beg to advise that neither of the two pieces comply with new code requirements." Of course, in the latter instance, the reason was that the wires were not labelled and tabbed with Laboratory labels.

The above is a sample of a number of similar instances which it can be readily understood cause considerable heart-burning to the parties injured, particularly where the goods are of high class, and, in fact, manufactured to a much higher standard than is required by the Laboratories themselves. Nevertheless, the inspector must reject them in many parts of Canada if they have not evidence of the approval of the U.L.C.

I will close my remarks on this heading by an extract from a letter from Mr. W. C. Robinson, chief engineer, after his visit to England, to Mr. Merrill, manager of the U.L.C., Chicago:—"As a result of all my conferences in England with manufacturers, insurance men, and others, I am of the belief that in a considerable number of cases English manufacturers will be likely to object to sending their products to any authority in the United States in order to secure insurance approvals for Canada."

The chief engineer of the U.L.C. was in England as recently as August-September last, and saw the managers and representatives of a number of British insurance companies while staying in London—Mr. Robinson having also visited Manchester, Liverpool and Birmingham, in accordance with Mr. Merrill's desire that he should endeavour to ascertain the attitude of English manufacturers towards the Underwriters' Laboratories. A copy of Mr. Robinson's letter or report to Mr. Merrill, dated September 20th (see Appendix J), should be carefully studied. I give the following extract as stated above, in London:—

The following was presented for the consideration of the Insurance Managers, and was discussed to some extent:—

"1. The possible desirability of in some way establishing the Underwriters' Laboratories in England in order to facilitate its business with English manufacturers and avoid misunderstandings relative to the approval of goods shipped into the United States and Canada.

"2. The question of what connections could be made and the best method for the conduct of the business in case it was considered desirable to establish the Underwriters' Laboratories in England."

I am of the opinion that there is a genuine desire on this side, both by the Canadian Fire Underwriters' Association and the U.L.C., to remove any cause for complaint which the British manufacturer labours under, but the insurance companies are not going (I think rightly) to permit uninspected goods to enter and be used from the U.K. or elsewhere, because they consider the risk is too great; an alternative method, therefore, safeguarding the insurance companies operating in Canada, should be evolved. The solution might be by—

1. A laboratory in Canada on the lines of the U.L.C.

2. A purely British laboratory, referred to at the end of Mr. Robinson's letter as "an independent agency."

3. A laboratory in England, to be practically an offshoot of the U.L. Chicago—run on similar lines, utilising the experience gained at Chicago, employing equally competent but British consulting and technical engineers. "The article," approved by label or tab, to be accepted by both the British and Chicago Laboratories. The same system of careful experiment and tests to be followed by careful consideration of reports before they are issued, and the adoption of the same or a similar system of "labelling and tabs," accompanied by some similar system of inspection.

I am of the opinion that the last, No. 3, would be to the advantage of the British manufacturer (No. 1 is open to many of the objections raised against the Chicago Laboratories); it would throw open to our British manufacturers not only the Canadian but the American market (see Mr. Robinson's letter), as the labels or tabs would carry equal consideration by inspectors throughout North America. Moreover, the policy should be extended, I believe, and made operative in Australia, New Zealand, South Africa, India—in fact, throughout the Empire, wherever British insurance companies operate and are in a position to insist on its adoption.

I venture to believe that, if our leading manufacturers are wise, they will join with the insurance companies and contribute towards the initial cost of starting such a laboratory and by annual subscription assist towards its upkeep. An understanding between our manufacturers on the one hand, and the insurance companies on the other, should lead to the happiest results. It should bring about the extension of the trade to British manufacturers of articles, appliances, materials, devices or systems dealing with fire hazard in the oversea markets, and be of advantage to British insurance companies in the direction of reducing the risks of "fire hazard."

The Value of the Elementary Electric Charge.—

At the meeting of the American Physical Society on November 30th a paper was read on "The Value of the Elementary Electric Charge," by Dr. R. A. Millikan, Professor of Physics in the University of Chicago. Dr. Millikan's demonstration of the ionic theory by the behaviour of droplets of oil in air when subjected to electric forces has attracted wide attention. The present paper gives a report of the results of the redetermination of all the factors that enter into the evaluation of the elementary electric charge by the oil-drop method. The chief modification of the method consists in working at all pressures between 2 cm. and 76 cm. of mercury in order to get an accurate value of the correction term to Stokes's law. The final result was: $e = 4{\cdot}774 \times 10^{-10}$ absolute electrostatic units, e standing for elementary electric charge. The probable error is not more than 0·2 per cent.—*Electrical World.*

TRADE STATISTICS OF AUSTRALIA.

THE following statement, showing the imports of electrical and similar goods into Australia during the year 1911, is taken from the recently issued official trade statistics. The figures for 1910 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1910.	1911.	Increase or decrease.
Plumbago or graphite.—	£	£	£
From United Kingdom ...	6,000	4,000	— 2,000
„ Ceylon	1,000	1,000	—
„ United States ...	1,000	2,000	+ 1,000
„ Other countries ...	2,000	1,000	— 1,000
Total ...	10,000	8,000	— 2,000
Gas and oil engines.—			
From United Kingdom ...	125,000	114,000	— 11,000
„ France	1,000	4,000	+ 3,000
„ United States ...	40,000	41,000	+ 1,000
„ Other countries ...	—	9,000	+ 9,000
Total ...	166,000	168,000	+ 2,000
High-speed reciprocating steam engines.—			
From United Kingdom ...	124,000	classification	—
„ Germany	11,000	altered	—
„ United States ...	40,000	(see below)	—
„ Other countries ...	4,000	—	—
Total ...	179,000	—	—
High-speed reciprocating steam engine, portable and traction.—			
From United Kingdom ...	not	120,000	—
„ United States ...	separately	61,000	—
„ Other countries ...	shown	2,000	—
Total ...	—	183,000	—
Other.—			
From United Kingdom ...	not	73,000	—
„ United States ...	separately	10,000	—
„ Germany	shown	4,000	—
„ Other countries ...	—	1,000	—
Total ...	—	88,000	—
Dynamo-electric machines up to 200 H.P., static transformers, induction coils, electric fans and parts thereof.—			
From United Kingdom ...	129,000	141,000	+ 12,000
„ Germany	23,000	36,000	+ 13,000
„ United States ...	73,000	90,000	+ 17,000
„ Sweden	5,000	6,000	+ 1,000
„ France	3,000	5,000	+ 2,000
„ Italy...	4,000	4,000	—
„ Switzerland... ...	2,000	1,000	— 1,000
„ Other countries ...	4,000	1,000	— 3,000
Total ...	243,000	284,000	+ 41,000
Dynamo-electric machines over 200 H.P., and parts.—			
From United Kingdom ...	22,000	17,000	— 5,000
„ Germany	1,000	2,000	+ 1,000
„ United States ...	3,000	9,000	+ 6,000
„ Other countries ...	—	1,000	+ 1,000
Total ...	26,000	29,000	+ 3,000
Generators for direct coupling to steam engines.—			
From United Kingdom ...	5,000	26,000	+ 21,000
„ Germany	7,000	—	— 7,000
Total ...	12,000	26,000	+ 14,000
Regulating, starting and controlling apparatus for all electrical purposes, including distributing boards and switchboards, except telephone switchboards.—			
From United Kingdom ...	19,000	21,000	+ 2,000
„ Germany	3,000	7,000	+ 4,000
„ United States ...	17,000	23,000	+ 6,000
„ Other countries ...	2,000	1,000	— 1,000
Total ...	41,000	52,000	+ 11,000
Flue-heated economisers, mechanical stokers, steam traps, steam turbines, superheaters, water purifiers.—			
From United Kingdom ...	56,000	82,000	+ 26,000
„ Other countries ...	—	1,000	+ 1,000
Total ...	56,000	83,000	+ 27,000
High-speed reciprocating steam engines for direct coupling or directly coupled to electric generators or to pumps.—			
From United Kingdom ...	30,000	37,000	+ 7,000
Motive-power machinery not elsewhere specified.—			
From United Kingdom ...	192,000	214,000	+ 22,000
„ France	5,000	11,000	+ 6,000
„ Germany	6,000	9,000	+ 3,000
„ Switzerland ...	1,000	3,000	+ 2,000
„ United States ...	72,000	91,000	+ 19,000
„ Other countries ...	3,000	5,000	+ 2,000
Total ...	279,000	333,000	+ 54,000
Electroliers, gasoliers, pendants, brackets, &c.—			
From United Kingdom ...	26,000	26,000	—
„ Germany	2,000	1,000	— 1,000
„ Other countries ...	1,000	1,000	—
Total ...	29,000	28,000	— 1,000
Electric fittings and appliances; switches, fuses and lightning arresters.—			
From United Kingdom ...	20,000	29,000	+ 9,000
„ Germany	6,000	8,000	+ 2,000
„ United States ...	6,000	9,000	+ 3,000
„ Other countries ...	3,000	1,000	— 2,000
Total ...	35,000	47,000	+ 12,000
Electric heating and cooking appliances.—			
From United Kingdom ...	2,000	2,000	—
„ United States ...	—	1,000	+ 1,000
Total ...	2,000	3,000	+ 1,000
Other electric light and gas appliances (except gas meters).—			
From United Kingdom ...	79,000	88,000	+ 9,000
„ Germany	43,000	47,000	+ 4,000
„ United States ...	19,000	22,000	+ 3,000
„ Other countries ...	13,000	14,000	+ 1,000
Total ...	154,000	171,000	+ 17,000
Rails, fishplates, &c., for railways and tramways.—			
From United Kingdom ...	400,000	499,000	+ 99,000
„ Belgium	15,000	43,000	+ 28,000
„ Germany	34,000	211,000	+ 177,000
„ United States ...	372,000	309,000	— 63,000
„ Other countries ...	—	18,000	+ 18,000
Total ...	821,000	1,080,000	+ 259,000
Telephones, telephone switchboards and appliances.—			
From United Kingdom ...	46,000	67,000	+ 21,000
„ Germany	5,000	7,000	+ 2,000
„ Belgium	10,000	18,000	+ 8,000
„ Sweden	40,000	32,000	— 8,000
„ United States ...	3,000	10,000	+ 7,000
„ Other countries ...	1,000	3,000	+ 2,000
Total ...	105,000	137,000	+ 32,000
Electrical articles: Accumulators, arc lamps, arc lamp carbons, cable and wire covered, carbon in blocks of 12 sq. in. and over, electrical vacuum tubes, measuring and recording instruments, prepared insulating tape.—			
From United Kingdom ...	277,000	430,000	+ 153,000
„ France	3,000	3,000	—
„ Germany	61,000	106,000	+ 45,000
„ United States ...	10,000	18,000	+ 8,000
„ Other countries ...	7,000	16,000	+ 9,000
Total ...	358,000	573,000	+ 215,000
Iron and steel wire.—			
From United Kingdom ...	116,000	111,000	— 5,000
„ Belgium	14,000	21,000	+ 7,000
„ Germany	381,000	320,000	— 61,000
„ United States ...	180,000	267,000	+ 87,000
„ Other countries ...	9,000	27,000	+ 18,000
Total ...	700,000	746,000	+ 46,000

Patent Revocation.—An order has been made revoking patent No. 26,810 of 1909, granted to the Mining Engineering Co., Ltd., and Charles Christiansen for "Improvements in chucks for rock drills."

ANOTHER VIEW ON THE CO-PARTNERSHIP QUESTION.

By W. T. WARDALE, A.M.I.E.E.

The idea of co-partnership is at present the fashionable remedy for all industrial unrest, and there is in many quarters a good deal of surprise expressed that the idea has not caught on with the industrial classes to any very great extent. In the opinion of the writer the cause of this want of enthusiasm, outside of one or two monopolistic trades, is to be found in the fact that whilst the immediate reward in the shape of extra wages is not great, the reward offered in the form of capital interest in the concern is also slowly acquired, and, moreover, for a long time the effect on the weekly income of the workman is quite insignificant. There is also the fact to be recognised that the method in which capital is allotted to the workman savours too often of charity or condescension and carries with it the yielding up of treasured rights in the way of strikes, &c. Now all of these schemes in one way or another tend to make the workman feel that he is under restriction, they do not give him any great incentive to strenuous personal efforts owing to the comparative smallness of the reward, and they are in many cases open to the fatal objections that the capital so obtained must not be disposed of without special permission from the firm, and often in return to some extent for this capital being held up as indicated, the interest is guaranteed. Both the above points are bad; they do not give the workman the elementary right of every holder of property to dispose of it when and how he desires; the man, therefore, has the feeling that the shares do not really belong to him as they should do, and that he has been led into surrendering old-established and valuable rights in return for something and nothing. In the opinion of the writer a most serious objection is that, the interest being guaranteed, the workman does not experience the effect of the ebb and flow of trade through his dividend, and therefore is as far as ever from realising from practical experience that the holding of share capital in any industrial concern does not mean the sure and rapid acquisition of wealth. Given the sympathy of the working classes most of the labour troubles will vanish, but this sympathy cannot be obtained for trifling advances in wages and the holding of small amounts of share capital under privilege. To get the best result it is necessary to make the workman and the shareholder as far as possible into the same person, but the share capital must be his without doubt and free from all restriction. The only way to enable such conditions to obtain is to enable the men to earn by their increased and maintained efforts considerably more than an ordinary week's wage. It will doubtless be at once suggested that piecework and premium bonus systems have been tried, and that where they have been a marked success the workman has through his trade union objected to and got rid of them. Whilst this statement is partly correct, it does not, however, include all the factors which are necessary to properly consider the situation. The reason must be sought as to why the men have been anxious to get rid of these systems. The old stock argument that the men are blinded by their leaders into accepting the opinion of the latter to the effect that these systems are hurtful to the men individually and as a body, is altogether too vague and true of only a small proportion of the men; a large body of men will not allow themselves to be deprived of a much larger income than is usual, merely in order to please their Trade Union leader, without there being some initial grievance to start the matter. In those works in which no advantage has ever been taken of the men in order to drop their prices on the flimsiest of pretexts, bonus and piece systems have, and still do, work well. But where it is a rule that, as soon as a man regularly earns more than a quarter above the usual time wage, the price per piece is dropped, and this game is carried on until the men are working at exceptional speed, merely for a trifle over the wage obtained under day-work terms, trouble is sure to ensue. That this rule held good in a certain district, the writer knows beyond dispute, and also the fact that, in the face of a most definite promise not to cut the rate under a premium bonus system unless the design had been altered or more efficient tools given to the men, the most trifling and useless differences have been made in the shape of one or two portions of the particular piece, and this piece brought forward as an entirely new job, with a new job number, and, of course, a much lowered price per piece. It is these tactics which have been the means of confirming in the minds of the men the tradition handed down to them, and kept alive by their leaders, that the employer is their natural and inveterate enemy, using his better education to trip up and take advantage of them at every possible chance; we usually then have the spectacle of the persons who have been responsible for these tactics soundly abusing the men because they do not work to turn out and earn as much as they could do.

Would any of us who are in official positions, I wonder, feel encouraged to increase the efficiency of our particular departments, if, by doing so, we found, at the end of the half-year, that we should in future be required to take charge of, and be responsible for, turning out a matter of 50 per cent. more work for no further increase in salary, but a good chance of the work demanded for the same salary again increasing if we had another record half-year?

There must then be established, first of all, in connection with any such scheme the absolute confidence of the men, and it also follows that this confidence must never in any way be shaken. Given this, the writer suggests the establishment of a regular piecework or bonus system depending on the class of work carried out. The men to understand that the man earning the biggest wage will be the man best liked in the place, and that in event of trade becoming bad, the men who are capable of and willing to earn the big wages, will be the men who will be kept on, and that any men not earning the amount they might will be supplanted by others who will. Then offer to take care of any savings the men may make until the amount reaches £10; when this amount is reached, issue in return for it a share certificate for the full amount, the firm paying all charges, such as stamp duties, and hand the certificate over to the man with the absolute right to sell it the next minute if he so desires. If the qualification for a directorship be, say, £100, then allow the shareholding men to elect from amongst their number a representative on the board for every £100 so held. Whilst the men have their money on deposit with the firm, it would pay the firm to allow 5 per cent. interest on the amount deposited, on the understanding that if, when the necessary £10 were saved, the money was not invested with the firm, it must be drawn out and the chance of the 5 per cent. interest lost. A man, of course, could be allowed to invest as many £10 as he could save.

The question then arises, can the men under any such system earn sufficient to enable them to lay by enough money in a short time to accomplish this idea? The answer is undoubtedly in the affirmative.

The following incident will amply illustrate this. About a year ago the writer was invited to read a paper before the Engineering Society in a northern textile town, and chose for his subject the question of factory driving. The only person known in the town was a solicitor, who was good enough to propose tea at his club, and the support his presence would afford at the reading of the paper. During a pleasant chat over tea a gentleman joined us who was, with his brothers, one of the largest textile men in the town, as they owned six large mills. It was not long before my friend mentioned the object of my visit, which at once led to an interesting conversation on power production. Then came the following observation: "It is, of course, always acceptable to us to have you engineers showing us how, by adopting various methods, we can save so much a year; but can you show us how to stop a waste which costs the mills, which belong to our firm alone, thousands of pounds per week?" "I refer," he continued, "to the waste which takes place owing to stuff not being produced, which ought to be produced, and which could be produced by our people if they would." He then unfolded a tale of deepest interest to employer and workman alike. Before one process in their mills could be carried out it was necessary for a pattern card to be made, and these patterns had to be made on hand-worked looms. In going into the matter of their costs of production, he was constantly met by the fact

that they were being delayed time after time by the waiting for patterns.

It was not only inconvenient to the firm to put down further hand looms for this work, but he was convinced that it was quite unnecessary, provided that the men would turn out the amount which they were able to. His firm, he informed me, had always paid for this work 30s. per week, though the district rate was 28s. a week. He announced to his brothers that he intended to take this matter in hand, and to that end called his pattern card men together, and told them that the firm had come to the conclusion that more work could be obtained from those looms than was being done, adding that he had considered what he could offer them as a commercially possible proposition, in order to make it worth their while to turn more work out. He then offered them an advance of 2s. a week, making the wage 32s. a week, and 4s. above the regulation trade rate being paid in the town. Work was settled down to under these conditions, and for a time some increase took place in the amount of work done per loom; but still the amount was less than what the owners thought easily possible. In one or two cases men had to be stopped for definitely refusing to try to turn out more work, though they took the extra money readily enough; to each applicant for a vacancy, and the conditions being known there were numerous applicants, the following statement was made:—"This is the best offer which we can make you for a weekly wage on this class of work, the conditions under which we have to compete for orders prevent us offering any more; we are offering you better terms than anyone else; what, therefore, are you prepared to do for us in return?" The usual reply was, "Well, I can make a pattern card as well as any man, and I am prepared to do so." The man was then greatly surprised to be told that this was not the point, the matter being then stated again definitely, "We are doing the best we can for you; are you in return prepared to do your very best for us—to turn out all the work of which you are capable?" The usual reply was that they would try to make the very best use of their time and abilities. The system settled down, and for a time the output increased, but not to the extent which the proprietors thought to be easily possible.

The next step taken in the matter was to call the pattern card hands together, and to inform them that the cost to the firm of their patterns was too high—viz., 4s. 6d., and that the extra weekly wage was to be abolished. The firm then set the whole of the pattern hands on to work at a piece price of 3s. 6d. per pattern woven. At this point my friend asked if there had been any objection to the price named, the manufacturer replying, "Yes, to some extent, but we have always treated our people fairly, and so they elected to try it. Now then," he said, "mark the result: to-day these same people, who were turning out their utmost—at least, so they assured us—on a weekly wage of 32s., are now drawing regularly, week by week, 42s., 45s., and some even as high as 52s. and 55s. in the case of one or two very expert men. Our patterns now cost us only 3s. 6d. each, we get twice the work through the pattern department at least, and that with the same capital cost for machines as before, the same cost for land value, taxes, rates, lighting and insurance of the buildings, and also for the insurance on account of the Compensation Act, and we have been enabled to set to work a large number of weavers in other departments of our mills whom we could not employ previously, as we could not get the patterns through fast enough to keep them employed."

"Now, then," he finally asked, "what is your remedy, as engineers, for this state of affairs? If it could be applied all round, wherever possible, both our workpeople and our manufacturers would be very much better off, and we should have such a pull in the markets of the world that this country would always be full of work." In bidding him good evening, after listening to his most interesting account, I half answered this question as to what engineers, who seek so strenuously after efficiency, are going to recommend in the matter, by reminding him that it was a totally different matter to come down to a plant which was wrong, and set it right, and to deal with so complex a quantity as human nature in the shape either of workmen or manufacturers. I could not, however, help thinking how great a pity it was that similar conditions could not be arranged for many other industries.

Just for a moment or two let us consider the effect on the daily life conditions of the people of such a movement. Here is a body of operatives brought up on, and living according to their own ideas on, a weekly income of 28s. By means of some method similar to that just described, the income of each individual operative is increased to say only 40s. a week, is it then impossible to the British workman's nature to act as follows:—Say 7s. per week spent in making life better worth living and more comfortable, and 5s. paid regularly week by week into the share purchasing fund as outlined previously. Surely if the workmen be assured of freedom from the old style iniquitous price-cutting system, the better end of them will soon readily grasp the idea and gladly fall in with it. The workman would thus become a shareholder solely by his own self-denial and in his own rights without any suggestion of charity or condescension about the matter, and with absolute freedom if he so desired to raise a loan at the bank on his share certificate either for backing his favourite at the Derby or any other little foolishness or wisdom.

Doubtless many of the present-day Trade-Union members may object to such a scheme on the grounds that it is only another fancy method of persuading the workman to speed up and ultimately to entice him from the Trade Union. If the Union leaders will not give any such system a trial, then they may depend upon it that they will suffer the loss of the most intelligent of the workers one by one as they make trial of and find such a system a great help and benefit to them in their efforts to obtain something better than a fixed rate of wages on a somewhat low level, which wage and conditions are enjoyed by their fellows, be they far less skilful and willing or not. It must also be remembered that as Government sickness and out-of-work provision may become general to all trades, the benefits to be obtained solely from a Trade Union will not be so numerous as they are to-day, whilst the fact that the policy of the Union is against the better opportunities offered for a man to make himself more independent will take away many possible members. There need be no fear that the Unions would be gradually deprived of their members and also of their usefulness, as there would always be the necessity for the discussion of prices, with the difference from the present day price discussion, that the workers would have amongst their number many who had a distinct interest in the firm, and who would therefore be more inclined to see both sides of the question. There would also be plenty of work for the Unions to do in such matters as encouraging the younger members to fit themselves for managerial positions by providing scholarships at the local technical institutes for such of their members who had passed at least three years in the works and who were developing into reliable craftsmen—youths who had already shown by their efforts at the evening schools that they were capable of something better than a working position, and also that they were ready to do the necessary study to fit themselves for the higher posts. Another way in which the Unions could do useful work would be in making firmer and extending the superannuation benefits.

If, however, the attitude of the unions is to be one of bitter hostility, then they will have to face the fact that the speeding up will nevertheless take place, and that it will take place under the present rates of wages, the workman thus being worse off to the extent of the extra money he could have earned under some such system as indicated. When he finds that this has been the result of following the advice of his leaders, will he still be willing to obey and follow out their further advice? Will not the danger be then that the Unions will fall to pieces owing to the fact that they have rendered things worse and not better for their trade? Depend upon it, that just as the workman of to-day is sufficiently educated to refuse to work under conditions which his father thought to be heaven-sent and inevitable, so will the time soon come when the new generation will see, and see clearly, that it will either be some form of partnership or an increased speed of work for the present rate of wages.

Co-partnership under the above conditions can and does work successfully in more than one industrial works, which

have to compete in the open markets for work. They are successful because they are scrupulously fair to the workman and not in any way charitable.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this ournal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

28,929. "Tube coupling for electrical circuits and other purposes." J. H. JACKSON. December 16th.

28,930. "Engine starting apparatus." P. M. JUSTICE. (North-East Electric Co., United States.) December 16th. (Complete.)

28,944. "Apparatus for connecting conducting and other wires." A. FODOR. (Addition to 23,618 of 1907.) December 16th. (Complete.)

28,953. "Salicylate electrolytes for use in the electrolytic deposition of metals or metallic alloys." P. MARINO. December 16th. (Complete.)

28,967. "Electric current transformers." E. C. WESCOTT. December 16th. (Complete.)

28,977. "Electric circuit closing apparatus." H. WADE. (Protective Signal Manufacturing Co., United States.) December 16th. (Complete.)

28,979. "Conduits and electric conductors." H. G. COVENTRY and G. RUSHTON. December 16th.

28,997. "Apparatus for the electric stimulation of muscles." L. B. MILLER. December 17th.

29,006. "Air-driven turbine for generating electric current for driving an electric motor-car." J. T. BUCKLER. December 17th.

29,025. "Miners' electric lamps." J. MORRISON and R. S. GREENHALGH. December 17th.

29,036. "Electric telephones." L. G. HAMMER. December 17th.

29,042. "Devices for cleaning the globes of electric arc lamps and the like." R. L. IRELAND and C. A. CHAPLIN. December 17th.

29,057. "Printing telegraphs." E. C. R. MARES. (General Engineering and Construction Co., Ltd., Canada.) December 17th. (Complete.)

29,082. "Gyroscope which may be used in combination with a non-magnetic compass or with other instrument or apparatus." E. KLAHN. December 17th. (Complete.)

29,091. "Ignition systems." C. F. KETTERING. (Divided application on 28,903/11, December 22nd. Convention date, April 17th, 1911, United States.) December 17th. (Complete.)

29,104. "Electric gas lamps." F. SKAUPY. (Convention date, April 13th, 1912, Germany.) December 17th. (Complete.)

29,122. "Apparatus for injecting fuel into internal-combustion engines, and means for igniting the same." E. C. BLACKSTONE, F. CARTER and E. CARTER. December 18th.

29,134. "Methods of measuring and recording electric currents." H. FLINN. December 18th.

29,149. "Electric lamps for motor vehicles." A. A. GODIN. December 18th.

29,160. "Electric arc lamps." F. R. BOARDMAN, R. V. BOARDMAN and F. BOARDMAN. December 18th. (Complete.)

29,176. "Electric bandages, compresses, and the like." E. MORISOT. December 18th. (Complete.)

29,201. "Illuminators or reflectors applicable to electric or other advertising signs, and the like." W. GOULTON. December 19th.

29,244. "Secondary batteries or accumulators." G. C. KNIGHT. December 19th.

29,268. "Obtaining unidirectional high-tension discharges." SIR O. J. LODGE and L. LODGE. December 19th.

29,269. "High-tension insulators." SIR O. J. LODGE and L. LODGE. December 19th.

29,281. "Incandescent electric lamps." E. A. GRAHAM and W. J. RICKETS. December 19th.

29,297. "Electric transformers." BRITISH THOMSON-HOUSTON Co., LTD., and E. B. WEDMORE. December 19th.

29,302. "Electric bull's-eye lanterns or the like." S. STERN and BRITISH EVER READY ELECTRICAL Co., LTD. December 19th. (Complete.)

29,310. "Device for facilitating the removal or attachment of electric lamp shades." W. S. ROSS. December 20th.

29,311. "Tell-tale or alarm mechanism for use in connection with engine-room telegraphs." H. SMITH. (J. D. Smith, High Seas.) December 20th.

29,328. "Working Tyer's railway block telegraph instruments and the like." W. RICHARDSON and MAJOR MCCALLUM. December 20th.

29,334. "Apparatus for locating ignition faults in explosive engines." A. C. BENNETT and E. O. BURN. December 20th.

29,338. "Regulation of the pressure of electrical generation systems employing rotary converters." SIEMENS BROS. DYNAMO WORKS, LTD., and J. C. WILSON. December 20th.

29,349. "Electrical connector." H. HIRST and G. MAURICE. December 20th.

29,350. "Construction of electric irons." H. HIRST and G. MAURICE. December 20th.

29,351, 29,352, 29,353, 29,354, 29,355, 29,356, 29,357, 29,358, 29,359, 29,360 and 29,387. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING Co., LTD. (Automatic Electric Co., United States.) November 20th. (Complete.)

29,372. "Electric contact devices of the Swan type." R. HADDAN. (Ludenscheider Metallwerke Akt.-Ges. vorm. Jul. Fischer and Basse, Germany.) December 20th. (Complete.)

29,375. "Method of charging condensers in parallel and discharging them in series." COMPAGNIE GENERALE RADIO-TELEGRAPHIQUE. (Convention date, December 21st, 1911, Germany.) December 20th. (Complete.)

29,384. "Method of reproducing electric variations." H. DE FOREST ARNOLD. (Convention date, July 15th, 1912, United States.) December 20th. (Complete.)

29,389. "Refractory materials." BRITISH THOMSON-HOUSTON Co., LTD. (General Electric Co., United States.) December 20th.

29,396. "Means for securing the globes, shades or the like of electric light fittings." B. LAX. December 20th. (Complete.)

29,409. "Method of diminishing the electromotive forces induced in the commutation zones of commutator machines." A. HEYLAND. (Convention date, December 20th, 1911, Germany.) December 20th. (Complete.)

29,416. "Telegraphic receiving apparatus adapted to actuate a perforator, typewriter or analogous device." A. C. BARONIO and K. L. WOOD. December 20th.

29,422. "Gear for electrically operating machine tools and the like." J. P. HALL. December 21st.

29,450. "Combined windmill and dynamo-electric machinery." J. A. LEEMING. December 21st.

29,456. "Electric accumulators." B. HEAP and CHLORIDE ELECTRICAL STORAGE Co., LTD. December 21st.

29,461. "Means and method of operating liquid electric controllers and starters." R. F. BARKLOCHER and A. WEST & Co., LTD. December 21st.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

PROCESS FOR REDUCING SOLUBLE METAL SALTS FOR THE PURPOSE OF SUBSEQUENTLY ELECTROLYTICALLY DEPOSITING THE METALS PRESENT IN SAID SALTS. P. Marino. 24,562. November 4th.

ILLUMINATED SIGNS, ILLUMINATED ADVERTISEMENTS AND THE LIKE. C. P. Grundy and J. W. Browne. 27,007. December 2nd.

ILLUMINATED SIGNALLING APPARATUS OR THE LIKE. Westinghouse Brake Co. and H. G. Brown. 27,275. December 5th.

MATRICES FOR ELECTROTYPES. F. F. Pershke, E. H. Rudd and W. Matthews. 27,399. December 6th.

PRIME POWER GENERATOR KNOWN AS A HYDRODYNAMO. C. H. Howland-Shearman. 27,623. December 8th.

MINERS' SAFETY LAMP ELECTRIC LIGHT FITTING. D. Morrison. 28,420. December 18th.

SECONDARY OR STORAGE BATTERIES. W. Clark. (Compagnie Internationale des Accumulateurs Vedeka.) 29,318. December 29th.

1912.

ELECTRIC CLOCKS. British Thomson-Houston Co. and F. Holden. 722. January 9th.

METHOD OF NEUTRALISING ELECTRIC CHARGES FORMED ON TEXTILES, FIBRES, PAPER AND LIKE MATERIALS DURING THE WORKING PROCESSES. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 1,554. January 19th.

ELECTRIC HAND LAMPS. H. Lucas and W. H. Edwards. 3,011. February 6th.

ELECTRIC HEATING DEVICES. G. Cooper. 4,399. February 21st.

MAGNETIC CHUCKS. H. Humphreys. 6,139. March 12th.

APPARATUS FOR PRODUCING ELECTRIC CONTACTS AT ADJUSTABLE PERIODIC INTERVALS. Soc. A. Granoux et Cie. 8,989. April 16th. (October 10th, 1911.)

TIMING DEVICES FOR THE ELECTRIC IGNITION OF INTERNAL-COMBUSTION ENGINES. Firm of R. Bosch. 12,379. May 24th. (July 14th, 1911.)

TELEPHONE REPEATERS. Western Electric Co. (Western Electric Co.) 12,604. May 28th.

ELECTRIC BOAT HOISTS. Sir W. G. Armstrong, Whitworth & Co. and R. Wright. 12,761. May 30th.

COPYING OR LIKE TELEGRAPHIC APPARATUS. A. E. Rappenecker. 13,425. June 7th.

ELECTRIC MOTOR. H. L. Zabriskie. 13,487. June 8th. (July 15th, 1911.)

PNEUMATIC LOCKS FOR MINERS' ELECTRIC OR OIL SAFETY LAMPS AND MEANS FOR ACTUATING SUCH LOCKS. E. A. Hailwood. 20,302. September 6th. (Divided application on 24,305 of 1911, November 2nd.)

ELECTRIC FURNACES. E. Stassano. 21,281. September 18th. (Addition to 8,901 of 1911.)

Accumulators for Submarines.—The accumulators carried by a submarine are a most important part of its equipment. The battery is charged from petrol-electric generators when the vessel runs awash, and supplies the whole motive power when the vessel is submerged. Absolute reliability on the part of the cells is imperative, and no acid must be spilled, even if the vessel tilts considerably. Maximum energy must be stored in minimum space and weight, and the cells must be capable of maintaining a very high discharge rate for considerable periods, since the speed of the vessel depends on this, and speed is all-important. First cost is not a primary consideration, but it is essential that the storage battery, weighing ½ ton or so, should need minimum attention and repair, once it is installed in the hull of a submarine. The difficulty of thoroughly inspecting the cells in this confined space (let alone cleaning or repairing them) is enormous.

In 1901-2, the Lab. Centrale d'Electricité (Paris) tested a number of types of cells, in order to determine which was most suitable for use in submarines. Only five among 21 cells withstood 250 discharges. From the best cell 4,040 watt-hours were withdrawn during this period per c. dcm. of cell volume (*i.e.*, 950 watt-hours per kg. of cell weight). One of the five cells had specially large surface positive plates; the others were of pasted construction. The maximum energy output reached 23·6 watt-hours per kg. of cell weight (discharge in 54 hours), and the maximum power output was 516 watts per kg.

In some modern submarine cells recently tested, the plates are of grid type, and the positives are surrounded by asbestos sheathing, which greatly increases their durability. The plates are separated by perforated insulating sheets with vertical ribs, and the lugs of similar polarity are connected to lead strips by autogenous welding; two connecting strips per pole are sealed through the cover plate of each cell. The containing vessels are of ebonite, and are mounted in an oak frame. The plates rest on ebonite supports, ample space being left for the collection of sludge. A non-spilling gas escape valve is provided in the cover of each cell.

Tests on the new cells show an energy capacity of 30 watt-hours per kg.—a specific energy capacity 27 per cent. greater than was realised in the best 1901 cells. The progress denoted by this figure is even more remarkable when taken in conjunction with the long life of the new cells. The best result obtained during the recent tests was 456 discharges, corresponding to a total output of 1,336·6 KW.-hours, *i.e.*, 6,202 watt-hours per kg. of cell weight, or 23,910 watt-hours per c. dcm. of space occupied. As compared with the 1901 cells, the best of the new types shows a life 6·53 times as long, measured by total watt-hours output per kg., or 5·93 times as long, measured by total output per c. dcm. of space occupied.